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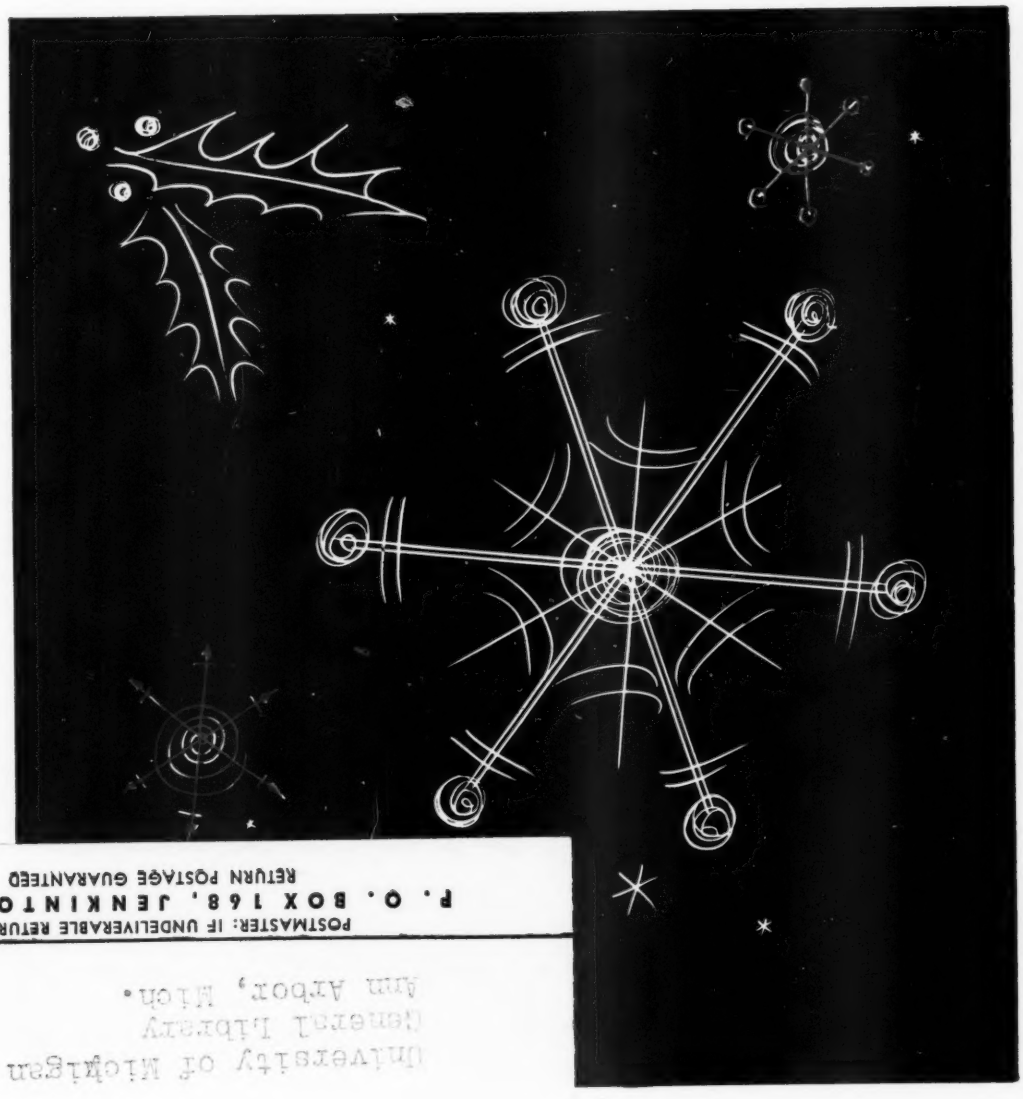
Volume 35 No. 12

December 1948

Plating

THE MONTHLY REVIEW OF THE AMERICAN ELECTROPLATERS' SOCIETY



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In this issue:

Copper Plating

Deposition of Precious Metal Alloys

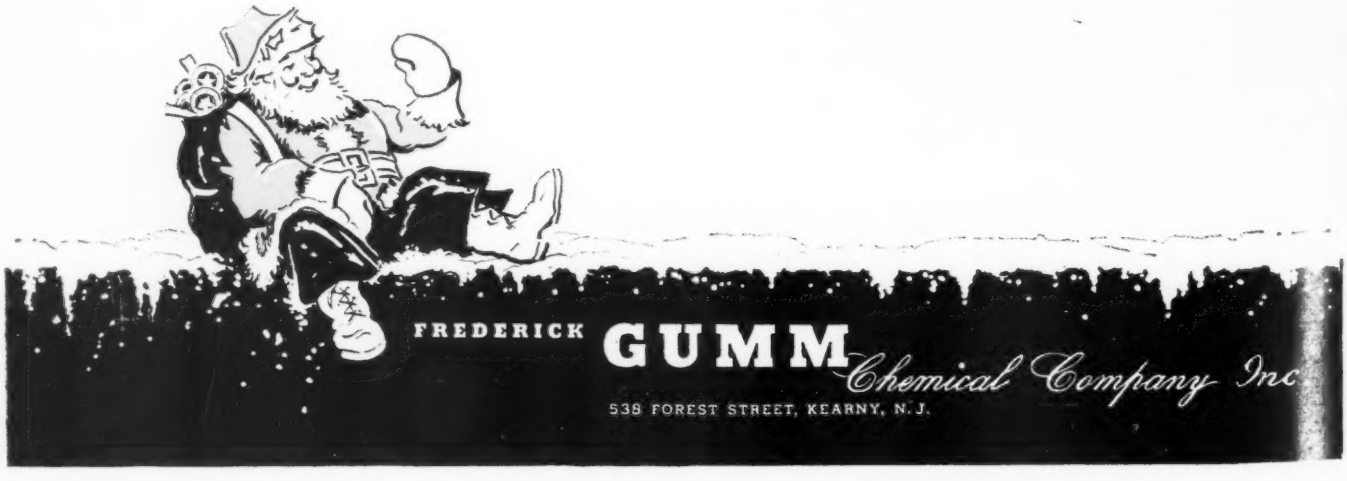
Current Reversal Devices for P R Plating

Physical Properties of Electrodeposited Nickel

Seasons Greetings

Once again we greet you at this Holiday Season . . . .

To You whose Friendship and Good will we Cherish may we say Thank you and also wish you a real Merry Xmas and a bright and successful New Year.



FREDERICK **GUMM** *Chemical Company Inc*

538 FOREST STREET, KEARNY, N. J.

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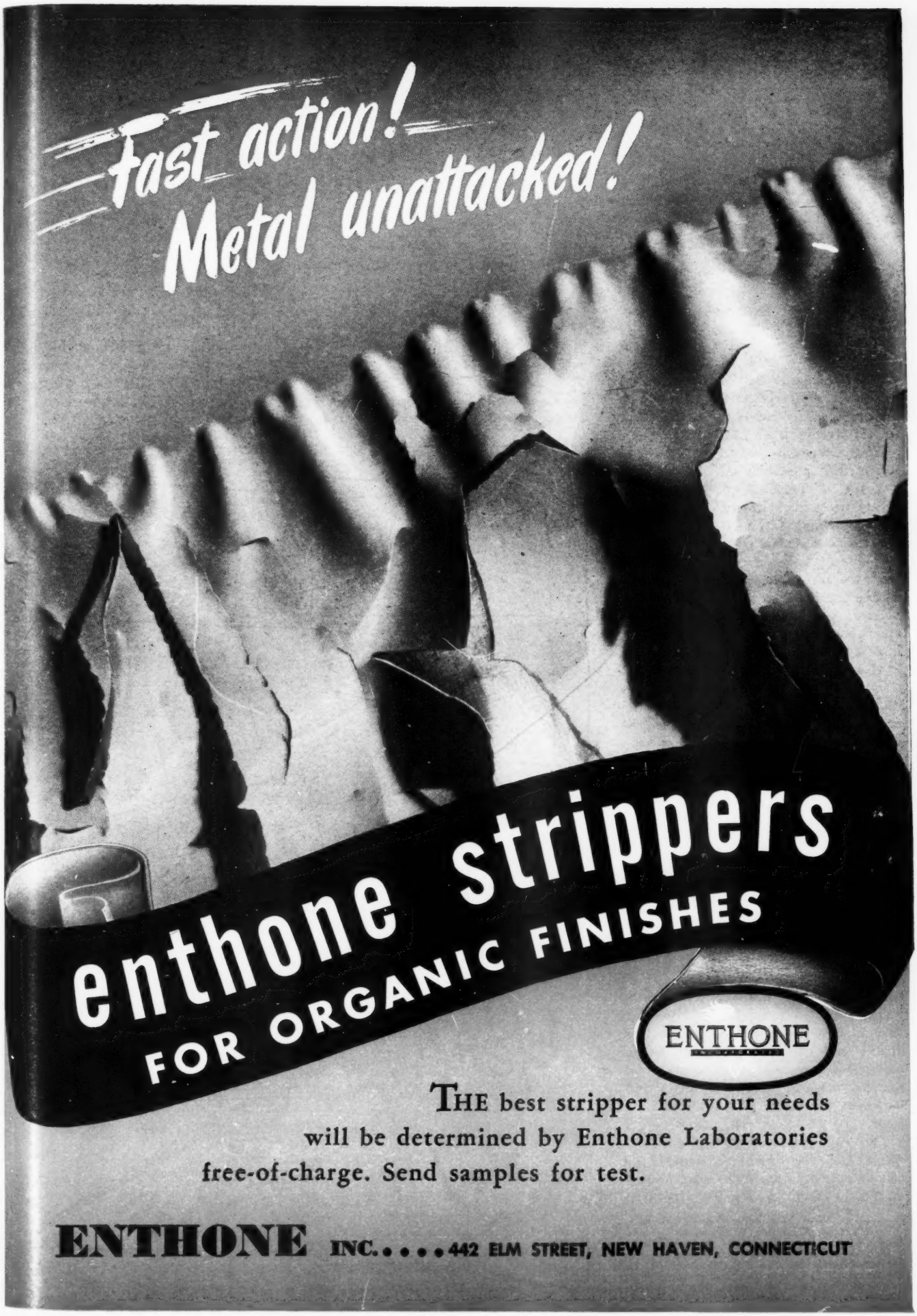
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Industry News

Titanium Metal. The du Pont Company has announced the beginning of small scale manufacture of titanium metal, a new basic raw material for industrial development.

A pilot unit of 100 pounds daily capacity has been successfully placed in operation at the Newport, Del., plant of the Pigments Department. This, so far as the company knows, is the first time ductile titanium metal has been produced for commercial exploration. The U. S. Bureau of Mines has been producing the metal for research purposes.

The silver-white metal is light and strong with a density of 4.5 and yield strength of 70,000–100,000 psi. It is highly resistant to corrosion and has a higher melting point, about 3140° F, than the commonly used metals. It is comparable to stainless steel in strength and corrosion resistance, but weighs only a little more than half as much per unit of volume. It is less than twice as heavy as aluminum, but several times as strong, in bars of comparable dimensions.

Titanium is plentiful in nature. It is the seventh most common metal and the ninth most common element in the earth's crust, and is more than a hundred times as plentiful as copper, zinc, or lead. However, since titanium metal is very difficult to separate in pure form from its ores, it has remained practically a laboratory curiosity since its discovery as a chemical element back in Revolutionary War days. There are enough workable deposits of rutile and ilmenite, the ores from which it comes, in the United States and Canada that America may become independent of overseas sources.

Most titanium metal which has been available heretofore has been in powder form; du Pont is now producing it in sponge form and will shortly make ingots weighing up to 100 pounds. Running 99.5 per cent plus in purity, the metal is ductile and can be rolled and drawn readily. The company will supply small samples without charge to industrial and university laboratories for testing.

The B. F. Goodrich Company of Akron, Ohio has recently announced the completion of its research center located on a tract of 261 acres halfway between Akron and Cleveland, Ohio. Utilizing the most precise and delicate instruments it is considered one of the most complete industrial laboratories conducting fundamental and applied research.

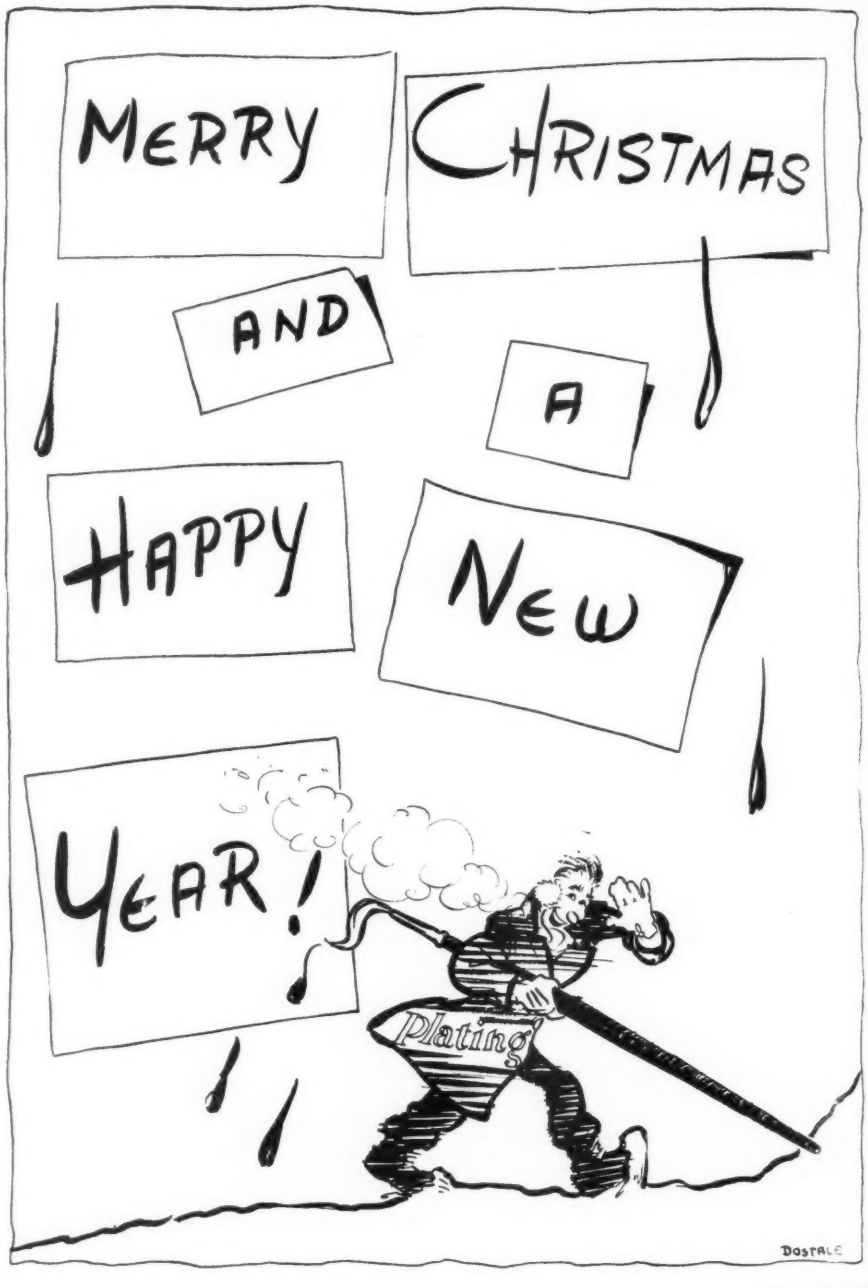
The main research laboratories and the connected engineering research units are housed in two three-story structures equipped with air conditioning to provide maximum of human comfort and protection of the precise instruments. Other features include a technical library, an assembly room, cafeteria accommodating 125 at one time, photographic and glass blowing facilities, etc.

There are now about 100 chemists, chemical engineers, physicists and engineers on the staff. In addition there are about 125 non-professional personnel.

Star Silver Plating Company, 5889 Portage Road, Kalamazoo, Mich., has recently been organized by Frank K. Savage to serve jewelers and others with silver and gold plating, lacquering, buffing, burnishing, oxidizing, restoration of antiques and repair of damaged articles, and metallizing of baby shoes. For further news about Mr. Savage, see Personals.

Cowles Chemical Company, Cleveland, Ohio, a closely held company since its founding in 1885, recently offered to the public 6,965 shares of common stock through a syndicate of four Cleveland underwriters. The underwriters reported that the entire issue was sold within forty-eight hours of the initial announcement of sale.

In a letter to stockholders, Mr. Edwin Cowles, President of the Company, explained that this financing will provide the firm with additional working capital to make possible needed additions to pro-



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A COMBINATION THAT IS HARD TO BEAT

Cowles

KW *and* SK

(Formerly SOAKLEEN)

All subsequent cleaning operations are reduced to a minimum by using K W alkaline cleaner and S K emulsion type cleaner together in the pre-soak operation. These two fast acting, efficient and economical cleaners do a real job of removing oils and stubborn soil when used in combination.

K W Cleaner alone will handle all cleaning operations after the soak cleaning. It can be used in still tanks—with or without electric current—and in all standard washing machines.

COWLES TECHNICAL SERVICE ON REQUEST

PROMPT SHIPMENTS FROM LOCAL STOCKS

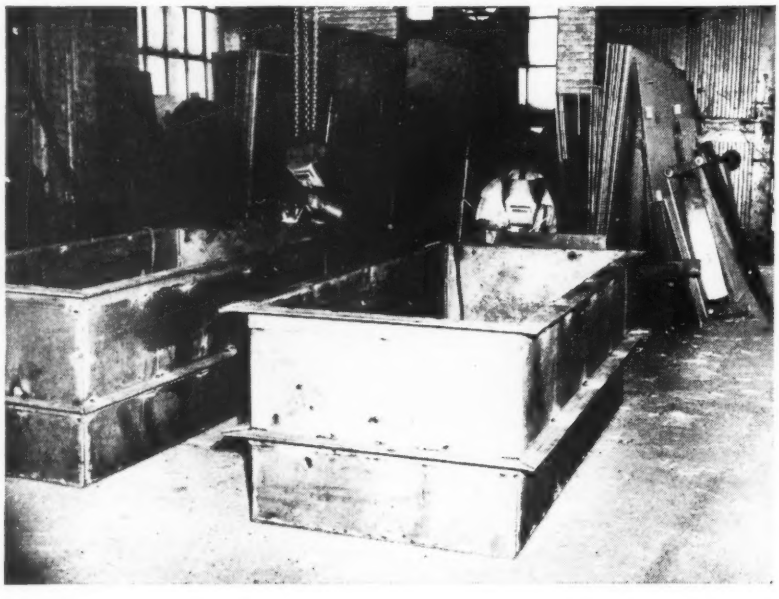
Cowles Chemical Company

FORMERLY THE COWLES DETERGENT COMPANY

METAL CLEANER DEPARTMENT • CLEVELAND 3, OHIO

You find the solution that's best for the job

We'll build the tank that's best for the solution



WHEN changing over to new products, new materials or new processes, tanks tailored to your needs—planned and designed with the right capacity for continuous performance—and with full provision made for preventing corrosion—are a worthwhile cost-saving investment. Storts' experience in the fabrication of single tanks and complete cycles for many hundreds of severe service requirements will help you to design for best economy—and standard Stortswelded construction is your assurance of prolonged and extensive satisfaction. We shall be glad to quote on your present needs—large or small.

STORTS WELDING COMPANY
INCORPORATED
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Manufacturers of Welded Fabrications to Specifications

Industry News

ductive equipment and to strengthen the cash position of the Company.

The Nutmeg Chrome Corporation, Hartford, Conn., of which A. E. S. First Vice-President A. W. Logozzo is the President, recently received a write-up in the Hartford Times in connection with the profit sharing plan which it employs. We quote:

"The profit-sharing plan is used to insure a higher quality of workmanship as well as a means of obtaining extra take-home money. After much careful study an organization chart was prepared assigning a certain percentage figure to each job. This percentage is based on importance to the organization, know-how required, effort and versatility. The total of the percentage, naturally, is 100. Accrued profits, in excess of what is needed to run the business and meet the ever-increasing extra-curricular costs, is taken quarterly and shared according to each individual's position in the organization chart.

"Besides the profit-sharing, the company provides hospitalization, group life insurance, and paid vacations.

"The working hours, ever since the founding of the company, have been 50 hours weekly. This includes five nine-hour days and a half day Saturday. Time and one-half is paid for all hours over eight hours daily and all Saturday work. It is a company policy to continue these extra hours to make for better take home wages, rather than work at 40 hours at straight time and employ more personnel".

The major activity of the company is hard chromium plating of plastic molds, dies, aircraft parts, gauges, machine spindles and cutting tools, especially taps. Recently the company expanded its facilities to include decorative copper-nickel-chromium plating.

Victor Chemical Works' New Mortisville, Pa., plant has now begun operations, according to Rothe Weigel, Executive Vice-President. This plant increases the number of plants operated by Victor to five and is the second to be completed in its post-war expansion program.

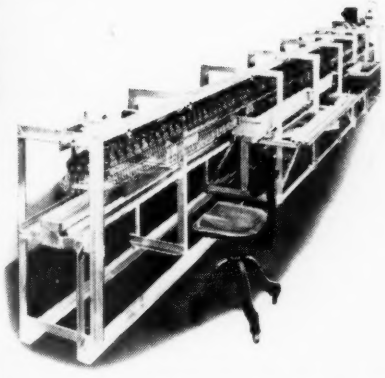
Started in October of 1947, construction at Morrisville has been completed on schedule. The new plant will produce phosphoric acid and other phosphate compounds for consumers in the East and on the Pacific Coast. It is under the supervision of E. L. Conant, Superintendent, who was formerly an Assistant Superintendent of the Company's Chicago Heights plant.

Elemental phosphorus, used at Morrisville in the production of phosphoric acid and other phosphates, will be shipped

MEAKER Electroplating Machines

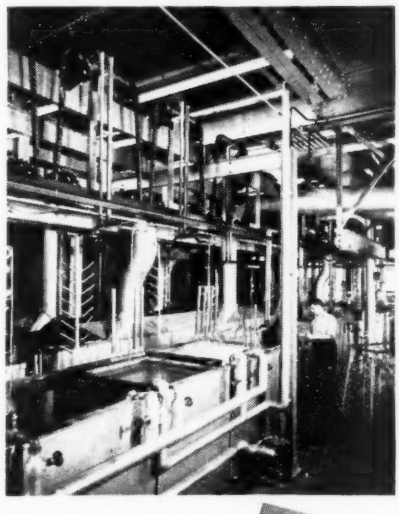
Tailored to Fit

Typical Meaker Straight-A-Way Automatic Machine. This machine was built for copperplating three rows of work simultaneously. It handles 125 racks per hour that are 16 inches wide, 14 inches thick, and 70 inches long.

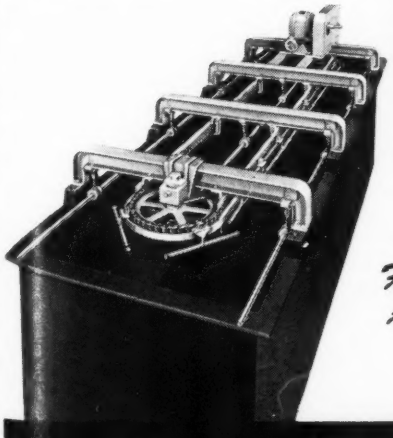


Meaker Special Machine designed for cleaning and silver plating small, brass contact clips. The unit is loaded at one point and the parts are carried through the operating sequence and automatically discharged into a container when completed.

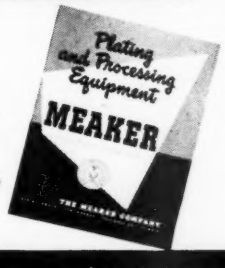
Meaker Return-Type Automatic Machine for chromium plating the large variety of parts in a high-quality line of plumbing hardware.



A Meaker Semi-Automatic Machine for use in medium-output plating departments. This type equipment is used in large, job plating plants to supplement the capacity of automatic machines.



Write for the Full Information. Ask for Booklet No. 148 →



Equipment tailored to fit your requirements, making every operation in the plating sequence automatic, or as mechanized as possible, is the profitable way to handle electroplating on a production basis. This Meaker method applies equally well to departments with only moderate daily output and to the largest and heaviest automatic plating needs of the mass production plants. It offers not only a lower unit cost, but the production is increased, and a better and more uniform quality of product is assured.

Serving the Plating Industry with the Best, Most Up-to-Date Equipment

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Alodized ALUMINUM

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ANCHORS THE FINISH
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NO ELECTRIC CURRENT

NO SPECIAL SKILLS

NO HIGH TEMPERATURES

SHORT PROCESSING TIME

Economical for either small or large plant operation, interrupted or continuous production. Write or call for descriptive folder on "Alodine".

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AMERICAN CHEMICAL PAINT COMPANY

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Industry News

from Victor's phosphorus producing plants located at Mt. Pleasant, Tenn., and Tarpon Springs, Fla. Additional capacity at Victor's Chicago Heights and Nashville processing plants is also nearing completion.

Industrial Filter and Pump Manufacturing Company, 1621-1639 W. Carroll Avenue, Chicago 12, Ill., well-known suppliers of filters, salt fog cabinets, and rubber linings and coatings for tanks, pipe, valves and fittings, has recently established an Ion-Exchange Department to furnish the plating industry with Industrial Demineralizers. This step, the company explains, is a national outgrowth of its twenty-one years of activities in the field of solution purification and clarification for better plating.

The Electric Products Company, Cleveland 12, Ohio, recently appointed **Hubert Kaub and Company,** Denver, Colo., as agent. It serves as direct factory representative covering the states of Colorado, Wyoming, Utah, New Mexico, and El Paso County of Texas.

The principals of this concern are Hubert Kaub and his son George, fourth and fifth generation natives of Denver and well versed in selling specialty electrical

George Kaub

Hurbert Kaub

equipment. Both have had a broad education and wide experience, having attended the University of Colorado and having intimate contacts with industrial equipment manufacturers. They will handle The Electric Products Company lines of industrial motive-power and hand-lift truck-battery chargers, electrolytic motor-generators, synchronous motors, and others.

This appointment is another step by The Electric Products Company to establish and develop strategically located representatives for a nation-wide service and selling organization.

Imperial Plating Rack Company has recently been formed in Flint, Mich., according to an announcement by E. L. Faulman, President of National Rack Company, Inc., of Fairlawn, N. J. The address of the new company is 800 Industrial Avenue.

The RIGHT ANSWERS to YOUR Questions!

HOW to STOP Plating Room Casualties due to Chromic Acid fumes?

HOW to SAVE costly Chromic Acid?

HOW to REDUCE maintenance and replacement costs of ventilating equipment, etc.?

NO-CRO-MIST IN YOUR BATH!

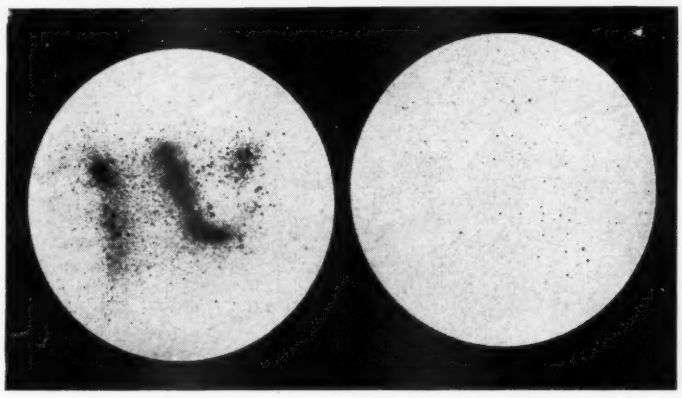
(THE ONLY SOLUBLE LIQUID ANTI-SPRAY PRODUCT)

DOES NOT float—it dissolves in the bath

DOES NOT cling to work and shield areas to be plated

DOES NOT drag over to rinse tanks and sewers

DOES NOT increase tri-valent chromium



Normal Chrome Mist — NO-CRO-MIST BATH (No Chromic Acid Mist)

ORDER 5, 25 OR 55 GALLONS . . . TODAY!

NO-CRO-MIST (THE ONLY SOLUBLE LIQUID ANTI-SPRAY PRODUCT)

DOES save up to 95% of the chromic acid usually lost in ventilation: reported savings up to 46% of the total chromic acid consumption

DOES eliminate fumes from the plating room

DOES keep busbars, racks, rack carriers and ventilating systems cleaner, saving labor and maintenance and giving better operation

DOES actually improve covering power of chrome

DOES extend operable sulfate ratio, thus simplifying control

DOES give remarkable results when used in plating baths containing from 25 to 45 ounces per gallon chromic acid at temperatures up to 130° F.

HOW to ASSURE positive control of Chromic Acid and other plating baths?

HOW to ELIMINATE sulfate and other catalyst analysis?

HOW to TEST a plating bath in 5 MINUTES?

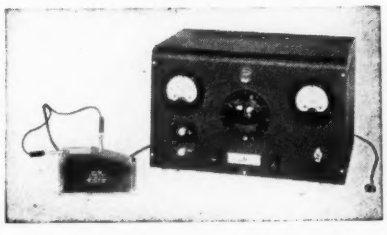
For Positive Chromium Bath Control . . .

USE THE 5-MINUTE HULL CELL PLATING TEST

. . . and forget sulfate or other catalyst analysis!

Regardless of actual sulfate ratio, the HULL CELL PLATING TEST specifically shows bath additions for BEST OPERATION!

USE IT ALSO FOR CONTROLLING — Bright Nickel, Copper, Cadmium, Zinc, Brass, Alkaline Tin and Silver.



Lucite Hull Cell with filtered Circuit Rectifier

TWO MODELS—with Filtered Output Rectifier for 110 Volt A. C. Current—NOW AVAILABLE: MODEL B-267 (for Hull Cell only) gives 5 amps.—0 to 15 Volts; MODEL B-1000 (for Hull Cell and General Laboratory use) gives 30 amps.—0 to 10 Volts, and 5 amps.—0 to 20 Volts.

YOUR PLATING DEPARTMENT NEEDS THESE PRODUCTS!!

Write TODAY, stating information desired on the ROHCO PLATING PRODUCTS described above. No obligation.

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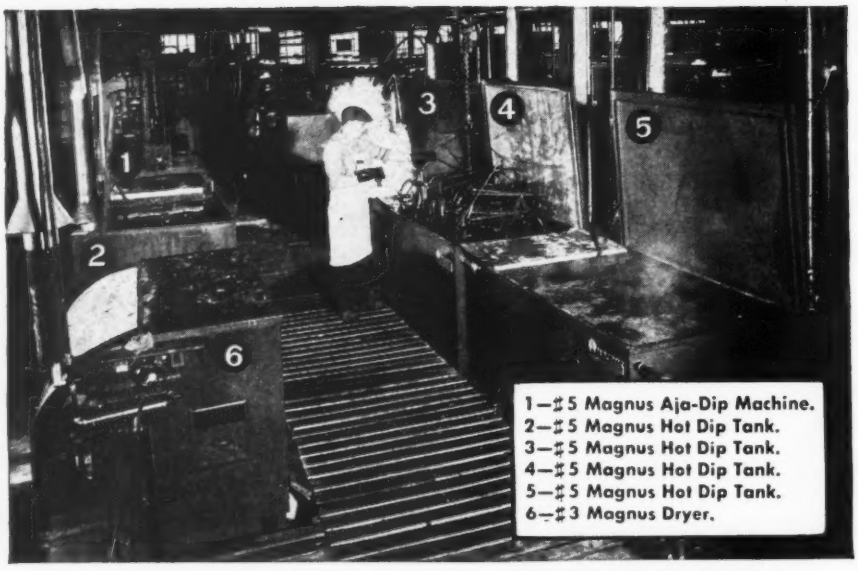
"YOUR PLATING IS BEST WITH THE HULL CELL TEST"



Magnus Cleaning Gives 10 TIMES THE OUTPUT AT HALF THE COST of Former Method

The Company: Large eastern manufacturer of metal toys, wrenches, shears, hammers, etc.

The Cleaning Job: Removing oil and drawing compounds from a wide range of parts prior to heat treating or enamelling.

Former Method: Vapor degreasing. Parts to be painted, hand wiped.

Magnus Method: *Painted parts* cleaned in a #5 Magnus Aja-Dip Cleaning Machine, using Magnus 94 XX. Rinsed in water in a Magnus #5 Hot Dip Tank, dipped in weak phosphoric acid in another #5 Hot Dip Tank, rinsed again in water, and finally dipped in weak chromic acid in a third #3 Hot Dip Tank.

Heat treated parts cleaned in the same #5 Aja-Dip Machine with 94 XX, then rinsed in water in a #5 Hot Dip Tank and dried in a Magnus #3 Drying Oven.

Results: Production 10 times that of former method. Parts are cleaner with no hand work. No toxic fumes. User says, "We figure our savings in material and labor at 50%."

The Magnus Aja-Dip Cleaning Machine with the suitable Magnus Cleaner can cut your costs and boost production, too. Write for suggestions on improving your present methods.

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IN METAL CLEANING IT'S **Magnus**

CLEANERS • EQUIPMENT • METHODS

● LETTER TO THE EDITOR

The Salt Spray Test

One of our friends in the industry, who for good reasons prefers to remain anonymous, has suggested that difficulties in meeting salt spray specifications should not always be blamed on the changes in the specification for carrying out the salt spray test, as might be inferred from our August editorial. He points to the many new nickel plating baths that have been developed and questions whether they produce deposits that provide as good protection as the baths used earlier and especially the Watts bath.

This point is certainly well taken. Early exposure tests showed quite a difference between different bright nickels, Dr. Ewing's report on the effect of copper in nickel plating baths in our last issue is another case in point, since it is well known that different baths have different sensitivity to impurities. That "nickel is nickel" is a very misleading statement is also shown in Dr. Brenner's report in this issue on the physical properties of nickel deposits.—EDITOR.

Industry News

(*Concluded from page 1190*)

It will engineer and manufacture all types of plating and anodizing racks, featuring a new removable and replaceable "Jiffy" tip. Insulation is guaranteed and is said to have been approved by all major suppliers of plating solutions.

Executive manager of the new plant is L. D. Paulman, who was formerly Sales Manager of National Rack Company and ho has a wide background in engineering, sales, and manufacture of plating racks.

The Fiber Chemical Corporation, new producer of chromic acid, is located in Cliffwood, N. J., and not in Clifford, N. J., as erroneously stated in the October issue.

New Plating Classes—The Baltimore-Washington Branch has started classes for electroplaters in both Baltimore and Washington. These classes are following the outline given in the A. E. S. Manual for Electroplaters' Science Course.

The Baltimore class meets one evening a week in a classroom of the Baltimore General Vocational School No. 298. The instructor is paid by the Baltimore school and there is no tuition fee. This class has an enrollment of about 25.

The Washington class meets one evening a week in the National Bureau of Standards. The fee for this class is $10.00 a semester, which is used to pay the instructors. This class has an enrollment of thirty-six.

The detailed outlines for the classes are prepared by the instructors and a committee appointed by the Branch.

FACTS ABOUT RECTIFIERS

Send for a complete set of reprints of the series of articles "Rectifiers for Electroplating" which appeared in METAL FINISHING between February 1947 and April 1948. These articles deal with rectifiers in general—not just with one particular make. No charge, no obligation—nothing but choice information that you will be able to use now or in the future.

ALSO AVAILABLE...!

The SELECTRO-PLATER Book

10-page book which gives the essential data on about 200 different types of standard, basic and remote control Green Selectro-Plater Units for production and job plating.

The BENCH RECTIFIER Book

Describes and illustrates a complete line of compact Green Rectifier Units for laboratory use or for production plating of small articles such as watch parts.

The MULTI-RECTIFIER Book

A single Green Multi-Rectifier offers a choice of 0-8, 0-16, 0-24, 0-48 volts, thus covering all important voltage ranges for electroplating, cleaning, anodizing. The complete power supply unit for research and testing.

Contact your nearest Green representative, or address your requests to us.

W. GREEN ELECTRIC COMPANY, INC.

SELECTRO-PLATERS AND ALL TYPES OF RECTIFIER EQUIPMENT

GREEN EXCHANGE BUILDING 130 CEDAR STREET NEW YORK 6, N.Y.

RECTIFIER G ENGINEERS

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Buffing and Polishing
COMPOUNDS-

STAND OUT!

To make your products stand out competitively, specify HARRISON cake or liquid compounds. Their fast cutting and quick cleaning action insure economy of operation.

SPECIAL: Harrison has developed a new dip compound that creates a head on the buff. You get a deeper cut . . . use less compound . . . save!

At your request, our experienced technical representatives will call to advise you on special problems.

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RACK COATING CUTS DRAGOUT

Unichrome Coating 218 permits company to set up continuous cycle of chromium!

By using Unichrome Coating 218, this well-known producer of brass products has now been able to eliminate reracking! They now use the same rack for copper, nickel and chromium without fear of dragging chromic acid into the nickel!

This accomplishment is due, first, to Coating 218's high gloss and smoothness—which contribute to its free-rinsing qualities. It is due, secondly, to the remarkable resistance of Coating 218 to severest plating baths and rough handling—no chipping, blisters or breakdowns to trap and drag over contaminants. Investigate this green, plastisol, baking coating for the many *other* advantages it also offers you. Write for details.

NO BAKING OVEN? Get the benefits of Coating 218 by sending your racks to coating applicator nearby who is set up to apply it. We'll send you his name.

UNICHROME
Trade Mark Reg. U. S. Pat. Off.

RACK COATINGS—Products of
UNITED CHROMIUM, INCORPORATED • 51 E. 42nd St., New York 17, N.Y.
Detroit 7, Mich. • Waterbury 90, Conn. • Chicago 4, Ill. • Dayton 2, Ohio • Los Angeles 13, Cal.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 856.

Personals

Charles E. Campbell has joined the sales force of Hanson-Van Winkle-Munning Company, Matawan, N. J., and will make his headquarters in its Detroit office.

Mr. Campbell is a graduate of the University of Toledo. Before coming to

Campbell

Hanson-Van Winkle-Munning Company, he was Assistant to the Chief Chemist at the Gordon Manufacturing Company of Toledo, Ohio. He has had substantial experience in the electroplating field, including production, analytical and control work, and trouble shooting.

Harry P. Smith, formerly New York District Sales Manager of Mathieson Chemical Corporation, has been made Assistant General Manager of Sales. His headquarters will remain in the company's New York offices.

A native New Yorker, Mr. Smith graduated from Columbia in 1921 with a B.S. degree. Prior to joining the Mathieson sales department in 1944, he was President of the George Chemical Company, now a division of Diamond Alkali Company.

Donald A. Metz has been appointed General Manager; **W. G. Sheane,** Sales Manager, and **John E. Forster,** Plant Manager of the Stamford Banch of the Atlas Powder Company's Industrial Finishes Department, Stamford, Conn.

Mr. Metz, until his recent promotion, was Assistant General Sales Manager at Stamford; he is a graduate of Sheffield Scientific School, Yale University. During the war he was in the Army, being discharged a Lieutenant Colonel, and was in charge of organizing and operating the Paint and Chemical Laboratory at Holabird Depot, Baltimore, Md.; later he performed the same duties at Aberdeen Proving Grounds. As Chief of the Laboratory, he directed research and development on the first lustreless finishes used by the Army on automotive and ordnance equipment.

Mr. Sheane, formerly a member of the Atlas Technical Staff in Stamford, is a holder of two degrees in chemical engineering; he is perhaps best known in the

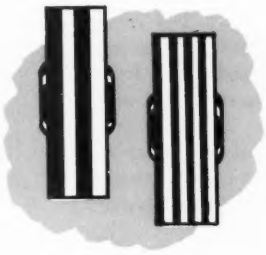
JACKSON AIRWAY *Ventilated* BUFFS *outwear and outperform other types of buffs*

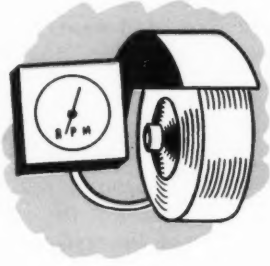
***Preferred* by men who use them, these buffs are faster cutting, cleaner and cooler running, will not ridge work, use less compounds, require less effort for better finish. *Preferred* by men who are accountable for increased production resulting in lower costs because they buff more pieces per wheel . . . cut buffing wheel costs 50%. Bring your buffing operation up-to-date . . . insist on longer lasting, money saving Jackson Airway *Ventilated* Buffs.**

NOTE THESE EXCLUSIVE FEATURES:

HALF AS MANY SECTIONS

Jackson Airway Ventilated Buffs have more material per section . . . are twice the width of conventional buffs. You buy half as many sections.





RUN AT HIGHER SPEEDS

Destructive internal heat generated at high speeds is eliminated entirely by the exclusive Jackson Airway Ventilation feature.

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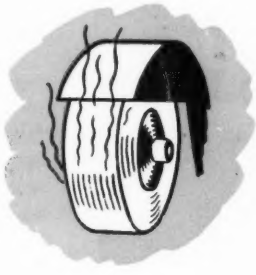

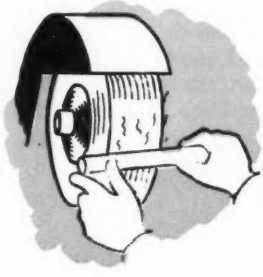

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Personals

finishing industry as a former Editor of Organic Finishing magazine. A graduate of Rensselaer Polytechnic Institute and Carnegie Institute of Technology, he is an active member of the American Institute of Engineers, American Chemical Society, and American Electroplaters' Society.

Mr. Forster, prior to being named to his new position, was Supervisor of the Plant Service Group at the Stamford Branch. During the war he was a captain in the Air Corps doing corrosion control work; he is a graduate of Yale University, an active member of the New York Paint and Varnish Club, and belongs to the Alpha Chi Sigma fraternity.

Casper Apeland continues as General Manager of the North Chicago operations, with **C. W. Craig** as Assistant General Manager.

G. L. Deniston, formerly of 1653 Glenn Avenue in Columbus, a member of American Electroplaters' Society, is now associated with Commonwealth Engineering Company in Dayton, Ohio. The company engages in industrial engineering consulting work and is owned by Toulmin & Toulmin, nationally known patent and contract attorneys.

Mr. Deniston is acting as supervisor of research and has charge of project development in research for industrial clients.

Frank K. Savage, who recently organized the Star Silver Plating Company (see Industry News), has been elected Vice-President of Graham, Crowley & Associates, Inc. Previous to joining the Chicago research and development group of this company, Mr. Savage was engaged in the development of electroforming processes with C. G. Conn, Ltd., Elkhart, Ind., where he was successively Chemist, Chief Chemist, and General Superintendent. He then became Superintendent of the Metals Division of Kuehne Manufacturing Company, Mattoon, Ill., and later Vice-President of the Standard Plating Rack Company, Chicago. Mr. Savage will direct company efforts in connection with consultation, research and development in the electroplating field in the Middle West to augment the corresponding operations of the company in the eastern area with headquarters at Jenkintown, Pa.

Savage

Other additions to the company's Chicago staff include **W. C. Pollard,** formerly with the Chrysler Corporation in Highland Park, Mich., who will do research in primary cells and related electrochemistry, and **James H. Conolly** who came from the Newton Falls Division of the Standard Steel Spring Company where he was electroplating and waste disposal engineer. Mr. Conolly will also do research in electrochemistry.

Dr. W. M. Langdon, who has been in the Chicago laboratory of Graham, Crowley & Associates, Inc., since he left Rensselaer Polytechnic Institute, was recently elected Vice-President of the Company.

Otto L. Schweng has been appointed to the newly created post of Director of Market Research for Diamond Alkali Company and will have his headquarters in the company's New York sales division at 570 Lexington Avenue.

Actively identified with the chemical field for many years, Schweng specialized in chemical investments during a 12-year period with Lehman Corporation and during the war served with the War Production Board as a chemical expert. For the past four years he has been Economic Specialist in the development department of General Aniline and Film Corporation, New York, N. Y.

Schweng was educated in New York City public schools and at New York University, where he majored in business administration. His connection with the chemical industry began in 1930 when, following several years in the Foreign Sales Department of Standard Oil Company (New Jersey), he joined Lehman Corporation.

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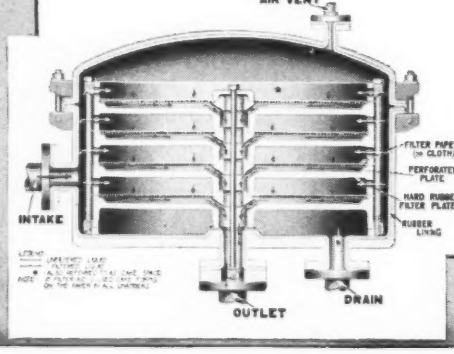

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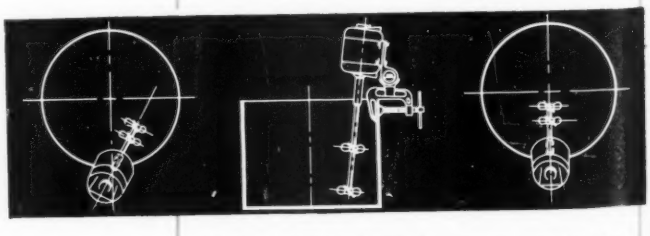

Left illustration shows the proper position for Mixing Shaft to give thorough mix without drawing air into the liquid.

Center illustration shows the normal position of shaft for general mixing.

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Editorial

December 1948

Merry Christmas

A NEW THING has come to pass in American life during the last few years, the full significance of which has not yet become evident to the average reader of the papers or listener to the radio: the scientist has stepped out of his laboratory or classroom and started preaching the Christmas gospel of Peace on Earth.

For generations he has helped create new things, and if they happened to be used for distinctive purposes, that was just too bad. With the release of atomic energy and the realization of its awful possibilities, the scientist has begun to understand that knowledge and material progress are not good in themselves but can be used equally well for good and for evil. He has finally grasped that he has very special responsibilities which have only begun when he has created something new.

The readers of this journal contribute daily to technological progress in some manner or another. What they do is being or can be adapted to destructive purposes just as much as the work of the atomic physicist. The difference is not one of kind but of degree.

The editors have carefully refrained from taking sides in day-to-day political controversy and do not propose to change that policy now. However, they feel it their duty to invite the readers to take a real interest in their country's affairs, foreign and domestic, to try to understand the issues as they present themselves, and to make their influence felt for the good of all. The responsibility is there, and no free man can shed it.

The Christmas message, "Peace on Earth", does not end there but continues, "to Men of Good Will". Will does not imply a weak longing but a strong determination. Only Men of Good Will have the right to look forward to a really Merry Christmas.

Gustaf Soderberg

COPPER PLATING

by R. M. WAGNER

Introduction

The deposition of copper is unquestionably the oldest form of plating. From the shades of antiquity when the first Assyrian dipped his gleaming blade into water colored with the mysterious disappearing blue stone and found it miraculously and ruinously "transformed" into the soft red metal which had already been familiar to his ancestors for centuries, the annals of science have been crowded with articles on copper plating. True, *electro*plating has been confined to the last century and a half, and any semblance of knowledge of its control to the last century, but even so the available literature is so vast that the scientific world must indeed heed any new writing on this subject "as the sea's self would heed a pebble cast".

From the plater's standpoint there are today, broadly speaking, two kinds of copper plate—that which we intend to buff, and that which we do not. Our wires occasionally get crossed and we produce one kind while aiming for the other. Many platers, through necessity or otherwise, use the same bath for both purposes, but general opinion currently holds that few, if any, copper baths are equally desirable for producing both buffable and bright deposits on all kinds of work.

Throughout the period of modern electroplating there have been used primarily two copper baths: the acid copper sulfate bath and the alkaline cyanide bath. The former underwent practically no changes until the past decade, while the latter began to be improved and developed somewhat earlier. Recently copper pyrophosphates[1], fluoborates[2] and alkanesulfonates[3] have appeared in plating baths, broadening the field somewhat.

Acid Copper Baths

Most of the outstanding improvements in plating have been made by suppliers of chemicals in an effort to promote the sale of their product. To these suppliers the industry owes a debt of gratitude. However, it is not surprising that until recent years little concentrated work has been done toward improvement and development of the time-honored copper sulfate bath, for the obvious reason that cheap copper sulfate does not have enough commercial possibilities to justify research for promotion of its use.

In the late 1930's there was a spontaneous, widespread awakening to the fact that something should be done about the inexpensive copper sulfate bath to make it produce bright or readily buffable heavy deposits. Of course, molasses, phenolsulfonic acid, glue, oatmeal and miscellaneous table scraps had in various places been added for years, but the bath still left much to be desired. Even the present writer caught the fever and did considerable experimenting with a sulfate bath made ammoniacal to suppress the cupric ion and buffered with ammonium sulfate. Difficulties with anode polarization and lack of time caused indefinite postponement of further work. However, the similarity in nature between the acid copper and nickel solutions was so apparent that many felt that improvements could be made which would compare with those brought about by bright nickel, if a similar amount of work could be expended on the copper bath. Oxalates, phosphates, various amines, benzene derivatives, and other organic compounds were added to standard or modified copper sulfate plating baths with varying degrees of success, and the old acid copper began to take on new life.

One of the most successful and economical of the new acid copper baths was developed by W. M. Phillips and F. L. Clifton of the General Motors Research Laboratories and consisted of the standard sulfate bath with small additions of thiourea and a wetting agent, with or without molasses[4]. This bath can be operated to produce fully bright deposits by careful control within a narrow range, but its principal value is in the semi-bright range where extremely soft buffable plate is obtained.

Cyanide Copper Baths

The cyanide bath, which has been and still is practically indispensable to provide a preliminary copper coating on metals other than copper, has received a great deal of attention throughout the past twenty years. The expense, toxicity, and relative instability of cyanides led to many efforts to substitute other chemicals for part or all of them. These efforts met with no success as far as producing a substitute, but did result in considerable improvement in the efficiency, life, and general usefulness of the cyanide bath, though many of the original disadvantages remained. Much work was done with chlorides and tartrates, and effects of varied concentrations of the standard constituents as well as allowable limits of carbonates, which constitute undesirable decomposition products, were investigated. Studies of effects of hexavalent chromium carried into the bath led to the valuable discovery by M. M. Beckwith[5] of the usefulness of sodium hyposulfite ($Na_2S_2O_4.2H_2O$), commercially known as sodium hydrosulfite and not to be confused with "hypo" or sodium thiosulfate, for removal of chromium.

The net results of all this work were the virtual standardization of the Rochelle salt cyanide copper bath[6] for strikes and light deposits and the development of the high concentration bath with addition agents for heavier deposits preceding bright nickel. The latter bath was developed by the du Pont Company and placed on the market as "high speed copper"[7]. Continuing research has resulted in improvement in the addition agent, and the introduction of the potassium bath. It now appears that the use of potassium cyanide to replace at least 50 per cent of the sodium cyanide has certain beneficial effects in raising the current density range, although the economic desirability of this is still questionable because of the increased cost of the potassium salt. Availability of cyanides has also been a factor at times.

Current Practice

So much for the general background of copper plating. The remainder of this paper will be devoted largely to current production practice in decorative plating of exterior automotive parts at the plant where the author's principal experience and interest lies. It should be noted that this is presented in the spirit of a report on present practice and not as a criterion, for it is felt that much remains to be done before the ultimate goal is achieved and that solutions and techniques still in the experimental stage or not yet conceived may well replace those herein described.

As remarked earlier, our two principal purposes for depositing copper are (a) to produce on steel a cheap heavy protective coating which may be buffed to a high lustre to obscure abrasive or die marks or other surface imperfections in the base metal; and (b) to deposit on die castings, or over the above-mentioned buffed copper deposit on steel, or directly on the steel where final finish is not too critical, a smooth, dense, fine-grained deposit over which bright nickel and chromium may be applied directly in continuous automatic conveyors to produce a commercially acceptable protective plate. In either case, our plate is preceded by a copper strike.

The Copper Strike

The copper strike consists of the standard bath containing Rochelle salts which may be added as such or as a proprietary tartrate solution. A typical composition is:

Copper cyanide	4.0 oz/gal
Free sodium cyanide	1.0 oz/gal
Rochelle salts	3.0 oz/gal
Sodium carbonate	3.0 oz/gal
Temperature	135° F

Electrolytic copper anodes are used here as in all our copper plating baths, although rolled copper is equally good and, with present manufacturing methods, cast anodes are also satisfactory. Time in the strike varies from 10 to 30 seconds when used prior to a high concentration cyanide bath into which it is transferred directly and from 3 to 5 minutes when used ahead of acid copper where, of course, thorough rinsing must intervene.

Since in the copper-nickel-chromium cycles our parts travel continuously through the complete process without reracking, there is always some probability of

● **R. M. WAGNER**

A graduate of Purdue University in 1928 with B.S. degree in chemical engineering, Mr. Wagner has served with Guide Lamp Division for over nineteen years as Chemist, Foreman, Supervisor of Plating, Assistant Superintendent, and Superintendent of Manufacturing Processes. The A.E.S. Proctor Award in 1938 and its Fifty Dollar prize in 1941 testify to his contributions to the plating industry.

contamination with hexavalent chromium due to pockets in rack coatings even though all possible care is used in rinsing. Presence of chromium is readily diagnosed from loss of efficiency and appearance of streaked deposits resembling "sunbursts" on curved parts. It is combatted by addition of the "sodium hydrosulfite" mentioned above. Unlike other materials, this salt should be added in solid form directly to the solution since it hydrolyzes when dissolved in water and loses its effectiveness. The reaction in the bath is primarily one of reduction, chromium being reduced to the trivalent state and then precipitated as chromic hydroxide. The latter may be removed by bulk filtration of the bath, in which case addition of some activated carbon to the filter is recommended to remove simultaneously accumulated oils and other extraneous material. Filtration is not absolutely necessary, but additional hydrosulfite treatment will be required periodically if it is not done, since the chromic hydroxide tends to redissolve in alkaline solution. This is particularly true in Rochelle salt baths in which the tartrates appear to combine with the chromium, later releasing it again in the hexavalent form under oxidizing conditions.

The G. M. Copper Bath

For the production of heavy, readily buffable copper plate on steel parts, the General Motors acid copper bath is used. Though requiring close control, this bath produces excellent soft, semi-bright deposits which color buff easily and which flow readily under the buff obscuring irregularities in the base metal finish more effectively than any other plate we have tried.

The nominal composition of this bath is as follows:

Copper sulfate	28 oz/gal
Sulfuric acid	5 fl.oz/gal
Thiourea	0.01 g/l
Wetting agent	Sufficient to maintain surface tension at about 55 dynes/cm
Temperature	75° F
Voltage	2 to 3

Agitation is desirable but not necessary. Its use permits somewhat higher current densities and promotes anode corrosion. Circulation of solution by pumping through perforated pipe underneath the work offers a means of agitation, although recently developed non-foaming addition agents now make air agitation the more practical.

Under proper operating conditions the higher current density areas are bright and the lower current areas semi-bright. Maximum average current density is probably 60–70 asf but is impossible to determine accurately because of the irregular shape and variety of the plated parts. Brightness decreases with increasing temperature and is completely lost at about 90° F. At temperatures below 70° F there is a tendency toward anode polarization caused by crystallization of salts on the anodes. Constant filtration is desirable to prevent roughness caused by powdery metal particles from the anodes, and there is some indication that use of anode bags or diaphragms may be advantageous. Parts should be regularly and thoroughly raked from the tanks because iron in appreciable quantities is detrimental and tends to cause formation of an insulating film on the anodes.

Brightener concentration must be maintained by observation of the character of deposit, and small additions should be made continuously, based upon ampere-hour data. An excess of brightener causes the deposit to become streaked or pitted and may be offset by additions of wetting agent which, however, also tend to nullify the brightening effect. The brightener and, to some extent, the wetting agent may be removed by treatment with activated carbon and filtration. Because of difficulty in handling large volumes of this solution, treatment is given by coating the filters with activated carbon periodically.

The "High Speed" Bath

For the further processing of copper buffed parts, together with die castings and with steel which does not require the high finish given by copper buffing, a copper-nickel-chromium cycle is used. Intermediate precleaning and preparatory treatments will not be discussed here. In this sequence the du Pont "high speed" copper bath is used, followed by bright nickel and chromium. Operation of the copper bath is in accordance with standards established by the du Pont Company and published in its literature. Typical concentrations and operating conditions are as follows:

Copper cyanide	8 oz/gal
Free potassium cyanide	1.5 oz/gal
Potassium hydroxide	5.6 oz/gal
Addition agent	8 cc/gal
Temperature	180° F
Cathode current density	10–40 asf
Anode current density	10–30 asf
Tank voltage	1.5–2.0 volts

Current should be applied immediately to work entering the bath since the high alkalinity may cause attack on die castings.

In general, our solutions are mixtures of sodium and potassium baths but concentrations are expressed in terms of potassium salts to avoid confusion. The bath is 100 per cent efficient under normal operating conditions, deriving this efficiency from its high copper concentration. The "high speed salts" from which the bath is originally built contain sodium thiocyanate in addition to copper and potassium cyanides. The addition agent is an organic mixture which serves to brighten and to control pitting.

Anodes are suspended in such a position as to be entirely submerged to avoid crystallization at the solution level of salts, which tend to wash off and cause roughness of the deposit. The suspension is accomplished by means of steel hooks which are

hooked through holes in the anodes, at least 6 inches from the top to allow for the enlargement of the holes as corrosion proceeds. Anodes are hung with the edges toward the work to assure adequate anode area, and approximately 3 pounds of anodes are originally provided per gallon of solution. Baskets of expanded metal, about 2 feet long, and wide and deep enough to surround the anodes, are suspended from the anode rods so that any anodes which fall from the hooks will be retained and continue to corrode by making contact with other anodes against which they lean. An alternate means of suspension consists of steel racks, each having several hooks projecting at about 60° upward from the horizontal on which the anodes are laid in horizontal position.

Agitation is necessary and may be provided by cathode movement or by pumping the solution through perforated pipes in the bottom of the tank; a combination of these methods is employed in our tanks. Continuous filtration is used. Temperature is automatically controlled; the solution should not be operated below 170° F because the anodes may polarize at lower temperatures, causing rapid depletion of the copper content. Automatic controls maintain the solution level by pumping from the reclaim tank which, in turn, is manually filled with softened water since the addition of hard water to this bath forms a precipitate which causes rough plate.

An anodic cleaner is desirable to remove any remaining film of addition agent before nickel plating. It is followed by a rinse and by a mild acid dip containing some of the wetting agent which is used in the bright nickel bath, into which the work is then transferred directly. The copper deposit ranges from bright to semi-bright and has a fine-grained structure such that bright nickel may be satisfactorily deposited on it.

Purification

Principal undesirable contaminants of this bath are organic impurities, excess carbonates, and hexavalent chromium. As in most other plating baths, organic impurities are removed by periodic treatment with activated carbon and filtration. Chromium is reduced with hydrosulfite as noted under the subject of the copper strike. Although the high-concentration bath will tolerate considerably more chromium than the strike, it is still seriously affected by relatively small amounts, and a mottled appearance gradually working into the "sunburst" effect will result from excessive contamination. In regard to carbonates, recent experience indicates that an equilibrium is established at about 18–19 oz/gal; no further build-up occurs when this concentration has been reached. Carbonates in this concentration do not appear to be detrimental and consequently we no longer worry about their removal.

Current Reversal

During recent years there has been considerable interest in the use of the current reversal technique in plating, especially with the "high speed" copper bath. This involves reversing the polarity of the generator by means of automatic timers at regular predetermined intervals so that the work is cathodic for several seconds and then anodic for a period approximately one-fourth of that time. During the anodic period, high points representing incipient roughness are preferentially deplated, resulting in a very smooth deposit. This technique permits—and requires—greatly increased current densities, resulting in greater speed of deposition without burning. With a 3 to 1 ratio of time, twice the normal current density would naturally be required to get the same amount of deposit as with normal plating, and any excess over this represents a gain in plating speed. This situation naturally calls for greatly increased generator capacity. The exact cycle to be used depends on the characteristics of the individual generator; in one installation we found a cycle of 12 seconds plating and 2½ seconds anodic to be the best. This particular bath, however, soon became filled with fine copper particles, resulting in a pitted deposit caused, apparently, when the particles were deposited and then removed by the reversal. This difficulty may have been due to inferior anodes because every kind of copper obtainable was being used in the bath at the time; or we may have used excessive current causing minute trees which were detached on reversal. There is some indication that anodes may have to be bagged if this process is used, in which case nylon bags or diaphragms are suitable. These early difficulties somewhat retarded its use, but there are indications that the process may have broad applications for various kinds of plating when the troubles have been ironed out.

Acknowledgment

Acknowledgment is made of the assistance of Mr. R. W. Oyler, Guide Lamp Division, General Motors Corporation, in the preparation of this paper.

References Cited

[1] T. G. Coyle, "Unichrome Copper", Proc. Am. Electroplaters' Soc. **29**, 113–117 (1941).

[2] C. Struyk and A. E. Carlson, "Copper Plating from Fluoborate Solutions", Mo. Rev. Am. Electroplaters' Soc. **33**, 923-934 (1946).

[3] C. L. Faust, B. Agruss, E. L. Combs and W. A. Proell, "Copper Plating in Alkanesulfonic Acid Baths", Mo. Rev. Am. Electroplaters' Soc. **34**, 541–549, 709–719 (1947).

[4] W. M. Phillips and F. L. Clifton, "Bright Copper Plating in Acid Baths", Proc. Am. Electroplaters' Soc. **30**, 92–99 (1942).

[5] M. M. Beckwith, "The Removal of Chromium Contamination from Alkaline Plating Solutions", Proc. Am. Electroplaters' Soc. **29**, 80–86 (1941); Mo. Rev. Am. Electroplaters' Soc. **28**, 543–549 (1941).

[6] A. K. Graham and H. J. Read, "A Study of the Rochelle Salt Copper Bath", Metal Ind. (N. Y.) **35**, 559–561, 617–621 (1937); **36**, 15–18, 77–80, 120–124 (1938). R. M. Wagner and M. M. Beckwith, "Rochelle Salt Cyanide Copper Baths", Proc. Am. Electroplaters' Soc. **26**, 147–167 (1938).

[7] H. L. Benner and C. J. Wernlund, "The High Efficiency Cyanide Copper Bath". Trans. Electrochem. Soc. **80**, 355-365 (1941); "Modern Electroplating", The Electrochemical Society, N. Y. (1942), pp. 173–183.

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Floyd F. Oplinger

FLOYD F. OPLINGER, Manager of Electroplating Service and Development in the du Pont Company's Electrochemicals Department, was born in Danielsville, Pa., in 1898. He attended Albright College, Myerstown, Pa., for two years, and was graduated from Franklin and Marshall College, Lancaster, Pa., in 1919 with a Bachelor of Science degree in chemistry. Three years later, he received a Master of Science degree in chemistry from the University of Rochester.

Prior to his association with du Pont, Mr. Oplinger was a chemistry instructor in the University of Rochester and the University of Maine, and spent several years with the National Aniline and Chemical Company at Buffalo, N. Y. and with the North East Electric Company, Rochester, N. Y.

In 1927, Mr. Oplinger went to work for the Roessler & Hasslacher Chemical Company as a chemist. Three years later, du Pont acquired Roessler & Hasslacher, and the following year, Mr. Oplinger was transferred to the New York Office as a service representative on sodium and cyanide products.

Since 1933, Mr. Oplinger has held a variety of positions in the fields of metal treatment and electroplating, in both Niagara Falls and Wilmington. In December, 1945, he was appointed Manager of Electroplating Service and Development.

Mr. Oplinger has contributed to the plating industry a distinguished list of inventions and developments for which he has been granted a number of patents and which he has described in publications. His first major contribution (with C. J. Wernlund) was in the field of tin plating from stannate baths in which he developed the first really successful commercial process, still widely used. Later he did much ground breaking in heat-flowing of tin, now so important in the manufacture of electrolytic tin plate. In the field of cyanide zinc plating he found the fundamental conditions under which bright plate could be obtained and discovered the nitric acid and the acidified hydrogen peroxide bright dips, also used on cadmium plate. In addition, he has been intimately connected with high-speed copper and brass (including white brass) plating developments and is known for his work on barrel zinc plating and plating of zinc base alloy die castings.

A member of the Electrochemical Society and the American Electroplaters' Society, Mr. Oplinger is a popular speaker at technical meetings. He is beloved throughout the industry, not only for his many valuable contributions but also for his ready wit and forthrightness. He is a member of Phi Sigma Kappa social fraternity.

Mr. Oplinger and his wife, the former Mary C. Attridge of Rochester, N. Y., live on Paoli Road near West Chester, Pa. They have three sons and two daughters. Chicken raising and gardening are his hobbies, having replaced his early love, golfing.

DEPOSITION OF PRECIOUS METAL ALLOYS*

A. K. GRAHAM†, S. HEIMAN‡ and H. L. PINKERTON†

Introduction

The object of this investigation was the deposition of a silver-gold-platinum alloy of 60–20–20 per cent composition. The Sterling Silversmiths' Guild of America which sponsored this undertaking had previously completed an extended study of a series of cast alloys of precious metals with the object of finding a non-tarnishing, non-corroding alloy with the color of sterling silver. As a result of that work, the 60–20–20 alloy was selected and a program for the development of a satisfactory bath for its electrodeposition on sterling silver was initiated. In the early attempts, which were made by another organization, good alloy deposits were obtained from a bath containing the complex alkali cyanides of the three metals, no free cyanide, and sodium citrate to stabilize the bath against precipitation. The platinum content of these deposits, however, was apparently limited to a maximum of 8 per cent; when it exceeded 5 per cent, the silver content dropped precipitately and the gold content rose, giving a yellow instead of a white plate. A trace of free cyanide inhibited platinum deposition altogether and made this type of bath impractical. None of the usual adjustments of plating conditions or bath composition seemed to improve the situation.

Part I of the article is a report of a number of unsuccessful attempts to deposit the silver-gold-platinum alloy from alkaline solutions. Parts II and III to follow will deal with acid chloride electrolytes from which the desired ternary alloy can be deposited, although in an unsatisfactory physical condition. Many binary alloy deposits of precious and other metals of good physical character were obtained from the chloride electrolyte. In Part IV the authors will report on the successful deposition of good quality deposits of the silver-gold-platinum alloy with the required composition from both iodide and bromide electrolytes. From these latter baths, it was also found possible to deposit gold-platinum, silver-copper-platinum and other alloys which could not be had from the chloride bath.

PART I. ATTEMPTS TO DEPOSIT SILVER-PLATINUM-GOLD ALLOYS FROM ALKALINE SOLUTIONS

Cyanide Baths

The previous results were confirmed in our laboratory in that the authors were able to obtain an excellent white deposit analyzing 77 per cent silver, 17 per cent gold, and 6 per cent platinum. All attempts to increase the platinum content to the desired 15 to 20 per cent failed. Efforts to introduce platinum into the bath in a form other than the cyanide complex were unsuccessful. Whether the platinum was added as the ammino-nitrite, alkali citrate, alkali phosphate, nitrite, lactate, ammino-cyanide or alkali platinate, silver and gold salts precipitated from the bath. Apparently, the extremely stable platinum cyanide complex was formed at the expense of the cyanide in the double cyanides of silver and gold, thus precipitating them as insoluble cyanides.

Non-Cyanide Alkaline Baths

A survey was therefore made of the entire field of alkaline non-cyanide baths for silver, gold and platinum. In most cases, the published information is very meagre; Table I lists the alkaline solutions which have been reported for the deposition of these metals.

In order to simplify the work, attention was first

*The research reported in this series of articles was sponsored by the Sterling Silversmiths' Guild of America.
†Consultants, Graham, Crowley and Associates, Inc., Jenkintown, Pa.
‡Now Chief Chemist, Philadelphia Rustproof Company, Philadelphia, Pa.

TABLE I. ALKALINE SOLUTIONS INVESTIGATED FOR DEPOSITION OF SILVER, GOLD AND PLATINUM ALLOYS

Key	Solution	Investigator	Silver	Gold	Platinum
a	Cyanide	.....	Yes	Yes	No[3,6]
b	Thiosulfate	Wiener[4]	Yes	Yes	?
c	Thiourea	Gockel[5]	Yes	Yes	?
d	Thiocyanate	Grube & Beischer[7]			
		Schlotter[8]	Yes	Yes	?
e	Amine-hydrocyanide	Mathers[9]	Yes	?	?
f	Oxalate	Gooch[10]	Yes	?	?
g	Lactate	Jordis[11]	Yes	No	Yes
h	Phosphate	Roseleur[12]	?	?	Yes
i	Ammino-nitrite	Keitel & Zschiegner[13]	No	No	Yes
j	Citrate	Bottger[14]	?	?	Yes
k	Nitrite	Wise[15]	No	No	Yes
l	Amino-cyanide	Raper[16]	No	No	Yes
m	Alkali platinate or aurate	Davies & Powell[17]	No	?	Yes
n	Complex sulfide	Smith[18]	No	Yes	?

confined to the binary silver-platinum system in an endeavor to find a bath which would codeposit these two metals. The deposition of silver-platinum alloys is scarcely mentioned in the literature. Campbell[1] in 1881 patented a bath made by dissolving coprecipitated silver chloride and ammonium chloroplatinate in potassium cyanide but gives no details of the deposition process. Fischer and Barth[2] in 1940 patented deposition of an alloy with up to 10 per cent silver from a bath containing ammonium chloroplatinite and the complex potassium silver cyanide. There is considerable doubt whether platinum can be deposited from such solutions. In attempts in our laboratory to reproduce the results of Fischer and Barth, black spongy deposits were obtained and the bath sludged heavily, but this is not necessarily conclusive evidence that the bath is inoperable. The chloroplatinite was prepared by us by reducing chloroplatinic acid with sulfur dioxide and then neutralizing with ammonia and, therefore, may have contained sulfites or amino derivatives which might have caused the difficulty.

In the exploration of the alkaline field, preliminary stability tests were made by preparing the individual silver and platinum solutions as recommended in the literature. Good sample deposits of the single metals were made from the individual baths, which proved that the baths were operable. Portions of the appropriate baths were then mixed and observed after several days for precipitation or color changes. The silver baths investigated were the thiosulfate, thiocyanate, thiourea, and lactate electrolytes. Attempts were then made to codeposit the two metals from alloy baths which appeared stable.

The deposits were prepared from 100 ml of solution in a 150 ml beaker held at the operating temperature in a water bath. Tantalum cathodes were selected because of the insolubility of this metal in hydrochloric or nitric acids or aqua regia. The tantalum was activated before plating by cleaning with crocus cloth[19] and then flashed with silver at a high current density. (A more satisfactory method of preparation of these cathodes will be described in Part IV.)

When mixed with the silver *thiosulfate bath* (b in Table 1), both the platinum ammino-nitrite and lactate baths (i and g) sludged heavily. The platinum phosphate bath (h) appeared stable with this silver bath, and the alkali platinate and platinum citrate baths (m and j) caused only a slight precipitation. Plating from the thiosulfate-phosphate combination (b-h) containing 5 g/l silver and 16 g/l platinum at 1 asf yielded a black plate containing 7.8 per cent platinum; the bath turned from pale yellow to dark red and sludged during plating. For the record, the compositions and plating conditions for this and other unsuccessful baths are presented in Table II. The deposits from a silver thiosulfate-alkali platinate bath (b–m) were black and spongy, containing no platinum. The silver thiosulfate-platinum citrate bath (b–j) containing 5 g/l silver and 7.8 g/l platinum at a *p*H of 6 and 10 were black and contained 3 and 2 per cent platinum, respectively.

With the silver *thiocyanate bath* (d), none of the platinum baths gave a perfectly clear and stable solution; however, the precipitation was only slight with the platinum lactate bath (g). The latter combination was stable on plating but yielded dark deposits containing only silver. Increased temperature had no effect, and raising the *p*H or adding ammonia gave even less satisfactory results.

When the silver *thiourea bath* (c) was added to the various platinum baths, only the combination with platinum lactate (g) was stable on standing. However, this bath sludged during plating and gave black deposits containing little or no platinum. The silver *lactate* bath (g) caused heavy precipitation with all except the platinum ammino-nitrite bath (i). From this combination, however, only silver could be deposited.

TABLE II. COMPOSITION AND OPERATING CONDITIONS OF UNSATISFACTORY SILVER-PLATINUM BATHS

Bath b–h Silver thiosulfate-platinum phosphate	
Ag, as AgCl	5.0 g/l
$Na_2S_2O_3 . 5H_2O$	20.5 g/l
$NaHSO_3$	2.7 g/l
Na_2SO_4	5.9 g/l
Pt, as H_2PtCl_6	16 g/l
$Na_2HPO_4 . 12H_2O$	300 g/l
$(NH_4)_2HPO_4$	52 g/l
*p*H	nearly neutral
Current density	1 asf
Temperature	80° F

Bath b–j Silver thiosulfate-platinum citrate	
Ag, as AgCl	5.0 g/l
$Na_2S_2O_3 . 5H_2O$	20.5 g/l
$NaHSO_3$	2.7 g/l
Na_2SO_4	5.9 g/l
Pt, as $(NH_4)_2PtCl_6$	7.8 g/l
Na-citrate	100 g/l
*p*H	6, 10
Current density	1 asf
Temperature	80° F

Bath b–m Silver thiosulfate-sodium platinate	
Ag, as AgCl	2.5 g/l
$Na_2S_2O_3 . 5H_2O$	10.25 g/l
$NaHSO_3$	1.4 g/l
Na_2SO_4	3.0 g/l
Pt, as $Na_2Pt(OH)_6 . 2H_2O$	10.0 g/l
Na-oxalate	5.1 g/l
Na_2SO_4	30.8 g/l
NaOH	5.1 g/l
*p*H	13
Current density	1, 2 asf
Temperature	80° F

Bath d–g Silver thiocyanate-platinum lactate	
Ag, as AgCNS	8.6 g/l
NaCNS	13.2 g/l
Pt, as H_2PtCl_6	10.0 g/l
Na-lactate	34.0 g/l
Na_2CO_3	2.0 g/l
NaOH	0, 2.0 g/l
NH_3, 28%	0, 15 ml/l
*p*H	6, 8, 11
Current density	1, 2 asf
Temperature	90, 150° F

Bath c-g Silver thiourea-platinum lactate	
Ag, as $AgNO_3$	5.0 g/l
Thiourea	30, 40, 50 g/l
Pt, as H_2PtCl_6	10, 20, 30 g/l
Na-lactate	34, 68, 102 g/l
Na_2CO_3	2.5, 5, 7.5 g/l
*p*H	5.5
Current density	1 asf
Temperature	90, 130° F

Bath c-i Silver lactate-platinum amino-nitrite	
Ag, as $AgNO_3$	3.2, 6.4 g/l
NH_4-lactate	15, 30 g/l
NH_3, 28%	2.5, 5 ml/l
Pt, as $Pt(NH_3)_2(NO_2)_2$	10 g/l
$NaNO_2$	10 g/l
NH_4NO_3	100 g/l
*p*H	8
Current density	1, 3 asf
Temperature	90, 130, 160, 200° F

Conclusions

While all the possibilities had not been exhausted, these rather extensive tests discouraged the authors from further work with alkaline baths, at least until the acid systems had been explored. The results with the latter type of solution were so satisfactory that the alkaline baths were not investigated further.

References Cited

[1]Campbell, U. S. Patent 248,554 (1881) and 253,159 (1882).
[2]Fischer and Barth, German Patent 688,398 (1940).
[3]Atkinson, J. Electrodepositors' Tech. Soc. **33**, No. 25 (1937).
[4]Weiner, Z. Elektrochem. **45**, 743 (1939).
[5]Gockel, Z. Elektrochem. **40**, 302 (1934).
[6]Grube and Beischer, Z. Elektrochem. **39**, 38 (1933).
[7]Grube and Beischer, Z. Elektrochem. **39**, 131 (1933).
[8]Schlotter, Oberflächentech. **12**, 43 (1935); German Patent 308,268 (1935).
[9]Gilbertson and Mathers, Trans. Electrochem. Soc. **79**, 439 (1941).
[10]Gooch and Feiser, Am. J. Sci. **31**, 109.
[11]Jordis, British Patent 11,298; U. S. Patent 570,554 (1896).
[12]See Ref. 3, p. 4.
[13]Keiter and Zschiegner, Trans. Electrochem. Soc. **59**, 273 (1931); Keiter, U. S. Patent 1,779,436; Zschiegner, U. S. Patent 1,779,457 (1930).
[14]Langbein and Brannt, "Electrodeposition of Metals", 9th ed., 1924, p. 536.
[15]Wise, U. S. Patent 1,970,150 (1934).
[16]Raper, British Patent 408,244 (1934).
[17]Davies and Powell, J. Electrodepositors' Tech. Soc. **13**, No. 26 (1937).
[18]Smith, E. F., "Electroanalysis", 6th ed., 1918, p. 173.
[19]Strock and Lukens, Trans. Electrochem. Soc. **56**, 409 (1929).

A. E. S. PUBLICATIONS

"The Fundamentals of Electrochemistry and Electrodeposition" by Samuel Glasstone. Price $2.50.

Twenty authoritative chapters in simple language on the properties of solutions, Faraday's Laws, pH, electrode potentials, overvoltage, polarization, anode behavior, corrosion, etc. Successfully used for classroom instruction.

Proceedings of the American Electroplaters' Society Vol. 33, 1946. Price now reduced to $5.50.

Twenty-one papers on copper, nickel, rhodium and tin plating; plating of strip and wire screen cloth; electrocleaning and electropolishing; magnesium treatment and parkerizing; polishing and buffing; organic coatings, etc. A. E. S. Research Annual Reports.

Proceedings of the American Electroplaters' Society Vol. 34, 1947. Price now reduced to $6.50.

Fourteen papers and eight A. E. S. Research Annual Reports on barrel plating of nickel and chromium; brass, cobalt and nickel plating; zinc treatments; electroforming; buffing; physical properties of and stress in electrodeposits; plating room waste disposal; health hazards.

"Adhesion of Electrodeposits" by A. L. Ferguson. A. E. S. Research Reports Ser. Nos. 1, 2 & 8. Price 60c, 40c and $1.00 respectively.

No. 1: Detailed bibliography, general considerations, correlated abstract of published methods for measurement of adhesion. No. 2: Correlated abstract of unpublished methods. No. 8: Appraisal of available methods; determination of adhesion through the use of cement.

"Determination of Impurities in Electroplating Solutions" by Earl J. Serfass and W. S. Levine. A. E. S. Research Report Ser. No. 3. Price 50c.

First in a series. Colorimetric techniques and methods for determination of lead, iron, manganese and copper in nickel plating solutions.

"Stripping of Copper from Various Base Metals" by F. C. Mathers, C. E. Landwerlen and E. C. Martin. A. E. S. Research Report Ser. Nos. 4 & 7. Price 35c and 70c respectively.

No. 4: Literature review and bibliography of a variety of methods. No. 7: The calcium and sodium polycyanide-sodium cyanide methods; deplating in cyanide solutions.

"Porosity of Electrodeposited Metals" by N. Thon and E. T. Addison, Jr. A. E. S. Research Report Ser. Nos. 5 and 10. Price 80c and 50c respectively.

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"Disposal of Plating Room Wastes" by B. F. Dodge and D. C. Reams, Jr. A. E. S. Research Report Ser. No. 9. Price 75c.

Bibliography, including more pertinent references to general pollution control and abatement, disposal of pickling liquors, and allied subjects.

"Methods for Testing Thickness of Electrodeposits" by H. J. Read and J. H. Thompson. A. E. S. Research Report Ser. No. 11. Price 50c.

Effect of internal stress (externally applied stress and annealing) on thickness determinations of nickel deposits by means of jet method.

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Adhesion of Electrodeposits

By CHARLES L. FAUST
Battelle Memorial Institute, Columbus, Ohio

and

ARTHUR W. HOTHERSALL
Armament Research Department, Woolwich, England

In the March, 1946 issue of "The Monthly Review" (with corrections in the April issue) Dr. Charles L. Faust, in commenting on Dr. A. L. Ferguson's reports on A. E. S. Research Project No. 3, suggested that the words "adhesive strength" be used to denote the force required to separate the coating at the interface between itself and the base metal surface. He further proposed that "bond strength" be measured by the force required to separate the plate from the base metal regardless of the place of fracture, and then proceeded to illustrate with photomicrographs how one may have perfect adhesion with all degrees of bond strength.

This was followed by an exchange of letters between Mr. Hothersall and Dr. Faust, which they kindly made available to the Editor. Lack of space prevented their publication at the time. However, the continued interest in the subject, as exemplified by the attention now given it by Committee B-8 of A. S. T. M., makes it desirable to print these letters at this time.—EDITOR.

MY DEAR DR. FAUST:

I read your letter to THE MONTHLY REVIEW of the A. E. S. for March, 1946 with much interest. I agree in general with what you wrote—in fact I have expressed the same principles in different words in various papers. But there are certain details, particularly the choice and definition of terms, which I find difficult to accept. As I think it is important for Americans and Britons to agree on definitions of technical terms, I am taking the liberty of writing to you to express my point of view.

The adjective "adherent", as commonly (non-technically) used without qualification, merely means showing no signs of detachment or peeling. As applied to coatings, I think that this word should never be used without qualification, because there is then a risk of confusion. This is also true of the noun "adhesion" when similarly used. For example, in Dr. Blum's discussion of my paper to The Electrochemical Society (included in the quotation in paragraph 5 of your letter and apparently supported by you) "perfect adhesion" is used to describe the degree of "stick" of nickel to cadmium which was easily peeled off as a composite film from a sample of steel plated with cadmium plus nickel. As I pointed out in my reply to the discussion, the most that could be said about the adhesion of this cadmium was that it was greater than the strength of the cadmium—how much greater no one can say. It seems to me to be liable to lead to a contradiction in terms to be able to describe a coating which can easily be pulled off as having perfect adhesion.

With regard to the term "adhesive strength", I do not think that, as defined by you, this strength would ever be measurable, because it is my belief that fracture never actually occurs at the true interface between coating and basis metal. To take a typical example, when a film of grease or colloid is present on the surface of the basis metal when it enters the plating bath (with the result that the plated coating can be detached with negligible resistance) the location of the fracture cannot be at the interface of the two metals because there is no metallic interface—the metals are separated by a non-metallic film; and if one pictures penetration of the deposit as tentacles through pores in the film, so that there are many tiny metallic interfaces scattered over the total interfacial area, it is these tentacles of deposit which will fracture when the deposit is forcibly detached. Hence, I do not think that your definition of "adhesive strength" is tenable.

In my view, the term "adhesion" should always be qualified to define the degree to which the coating sticks, irrespective of where the fracture occurs when the coating is detached.

In my papers I have used "adhesion" in the sense that you propose for "bond-strength" and I have described the quality of stick across the interface between the coating and the base as "intrinsic adhesion". In my view (and I would stress that this is largely surmise) this intrinsic adhesion must always be of a high order, greater than the shear strength of the weaker of the two metals at the surface: if so it is a property which can never be measured. I do not think that the term used to describe this interfacial strength is at all important provided that it distinguishes between the strength of the bond at the metallic interface and the mechanical force required to separate the coating irrespective of where fracture takes place; and that the terms selected do not in any sense in which they may legitimately be used contradict the ordinary, everyday meaning of words.

In my criticism of the term "adhesive strength" as you propose to define it, I do not think my disagreement with your proposal arises from any conflict of views on fundamental issues but entirely from the use of a word in different senses. This only goes to emphasize the importance of agreeing on the definition of the word adhesion and other words or terms used to describe whether and how tightly a coating sticks to the base on which it has been formed.

Yours very sincerely,

(Signed) ARTHUR W. HOTHERSALL.

(*Continued on page 1270*)

CURRENT REVERSAL DEVICES FOR P

A DEVICE WITH ELECTRONIC TIMING*

HAROLD J. READ† and ROBERT W. HALL‡

IN THE COURSE of an investigation of the effect of periodic current reversal on the structure of copper deposited from copper cyanide solutions, a current reversing device which may be of interest to others was constructed. It was assembled from odds and ends of equipment at small cost, and has proven to be accurate, versatile and reliable.

The basic idea is simple: a light beam shining into a photo-cell is interrupted according to the desired cycle, and the photo-cell output amplified sufficiently to actuate a relay which, in turn, operates a double-pole, double-throw relay which has been wired as a current reversing switch.

Fig. 1 shows the essential parts of the timing section of the device. The one-revolution-per-minute clock motor *B* revolves the cardboard sector disk *A* which is shown in greater detail in Fig. 2. The disk periodically interrupts a beam of light from bulb *F* which is directed into the photo-cell *C*. The latter is shielded from extraneous light by a cover with an opening at *D* to receive the light beam from a slit in the end of tube *E*.

The wiring diagram for all parts except the motor *B* and light bulb *F* is shown in Fig. 3. It is probable that almost any kind of vacuum photo-cell would work, but to be on the safe side, a cell having roughly the same characteristics as the Cetron 23D should be used. The type 25Z5 tube is employed as a rectifier-doubler to supply adequate plate voltage to the amplifier tube without the necessity of using a transformer. The type 38 amplifier tube is actually a pentode but has been shown as a triode since it was used as such by connecting the screen grid to the plate (the suppressor grid is permanently connected internally to the cathode). A wide variety of tubes may be substitited for the type 38 as long as the tube selected has a fairly high amplification factor and will pass about 10 milliamperes in the plate circuit when about 200 volts are applied to the plate. If a tube having a filament rated at something other than 6.3 volts is used, the 290-ohm line cord resistor must be changed accordingly.

Relay *Re.1* should have a coil resistance of about 5,000 ohms and operate with a current of about 2 to 5 milliamperes. It may be of light construction with small contact points. On the other hand, relay *Re.2* should be of construction commensurate with the current to be broken in the electrolysis circuit. Very moderately priced relays are available which will break 10 amperes (DC) with ease and reliability. It will be noted that a 100-volt coil is used on *Re.2*. This is, of course, not mandatory, and any type coil for which suitable voltage is available could be used.

The milliammeter *M.A.* should have a range of about 0 to 15 milliamperes and need not be a permanent part of the apparatus. It is, however, very useful in making the initial circuit adjustments. The authors used an exceedingly cheap meter (59 cents, pre-war) with complete satisfaction.

The fixed 50-megohm resistor need be only the 0.5-watt size while the 0.1-megohm and 3000-ohm variable resistors are cheap radio volume controls. The 16-mfd condensers are of the dry electrolytic type (250 volt). The resistor in series with the tube heaters must be chosen with due regard for the tubes used; a regular line cord resistor is best suited to this purpose.

The light shield for the photo-cell was made from the cardboard carton in which it was packed, and the extension *D* was simply a cardboard tube of square cross-section pasted to the photo-cell carton. The

(*Continued on page 1225*)

*From a thesis presented by Robert W. Hall in partial fulfillment of the requirements for the degree of Bachelor of Science in Metallurgy.

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PR PLATING IN THE LABORATORY

A DEVICE WITH MECHANICAL TIMING

H. L. PINKERTON*

AN EASILY constructed mechanical device for periodic reversal of small currents has been used in our laboratory for about two years. It has proven quite flexible in its operation, and the wide range of cycles obtainable has rendered it very useful in the investigation of periodic reverse current electroplating.

Provision is made for the following features:

1. Simultaneous reversal of current to cell and of voltmeter across cell.
2. Variation of total length of cycle from 1.5 to 180 seconds.
3. Minimum duration of one side of cycle of 0.15 seconds, maximum duration of 90 seconds (half of longest total cycle).
4. Separate and independent control of current in cathodic and anodic parts of cycle.
5. Compound cycles, i. e., periodic alteration from one cycle to another, but with manual shifting between cycles. This could be made automatic also, but was not considered worth the effort.

There are two disadvantages inherent in the design to be described:

1. The time between "break" of the direct current and "make" of the reverse can be quite appreciable at low machine speeds.
2. Sparking at the mercury contacts limits the permissible current that can be used.

Changes in the design to improve these conditions will be described.

Fig. 1 is a sketch of the essential mechanism. The wheel, W, can be rotated at controlled speeds varying from ⅓ to 10 rpm. In our design this was accomplished by using a variable-speed motor as source of power and gearing down through a double worm reducer. Very little power is required. The wheel carries on its circumference one or more adjustable cam sections, C, which trip a tilting switch block, S, at predetermined intervals. For convenience, the holes H which carry the cams are indexed 9° apart, or 40 to the circumference. Three sizes and two thicknesses of cams are provided. These are in the shape of a sector of an annulus either 9°, 18°, or 36°, i. e., 2.5 per cent, 5 per cent or 10 per cent of the circumference. Thin cams are of sheet metal, thick cams of wood faced with metal. The trip T is pivoted so that when compound cycle operation is desired it can be shifted to the dotted-line position shown in the figure; the dowel D holds the trip in the selected position. When the trip is in the normal (full line) position, both sets of cams engage the trip; when it is in the alternate position, only the thick cams operate. The cycle which requires the block to be depressed the greater percentage of the time is therefore set using the thin cams. The trip is pivoted manually to shift from one cycle to the other. After the trip has been released by the cam, the block is returned to its normal position by the lead counterweight L.

Cam design is shown in Fig. 2. The line V-V' is the vertical passing through the center of the wheel or is otherwise fixed and known. It represents the position of that radius of the wheel which is the leading edge of the cam when it has moved the trip T so that contact has just been made with the mercury pool M as shown in Fig. 2A. Since the width of the base of the cam represents the reversal portion of the cycle, it is required that the switch-block return to its normal position at the moment when the trailing edge of the cam reaches the critical line V-V' as shown in Fig. 2B. To accomplish this, part of the trailing edge of the cam must be cut away as shown so as to free the trip. A template for cutting the cams can readily be made from a full-scale layout.

It will be observed that if four 2.5 per cent sectors, for instance, are equally spaced around the wheel, the effect is that of a cycle with a 10 per cent sector four

(*Continued on page 1224*)

*Consultant, Graham, Crowley & Associates, Inc., Jenkintown, Pa.

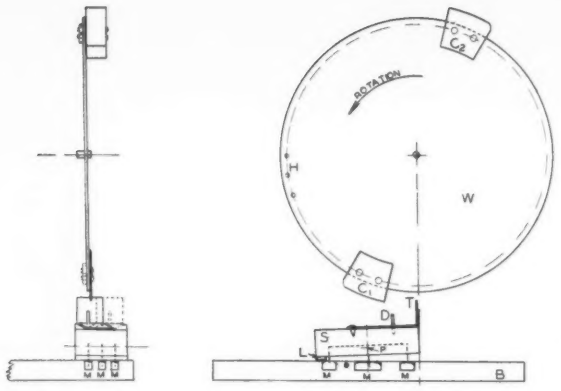


Fig. 1. Sketch of reversing mechanism. B, wooden base; M, mercury pools; S, switch block; T, pivoted trip; D, positioning dowel; P, pivot of block; L, lead counterweight; C_1, thin cam; C_2, thick cam; W, wheel; H, 40 holes indexed 9° apart around circumference

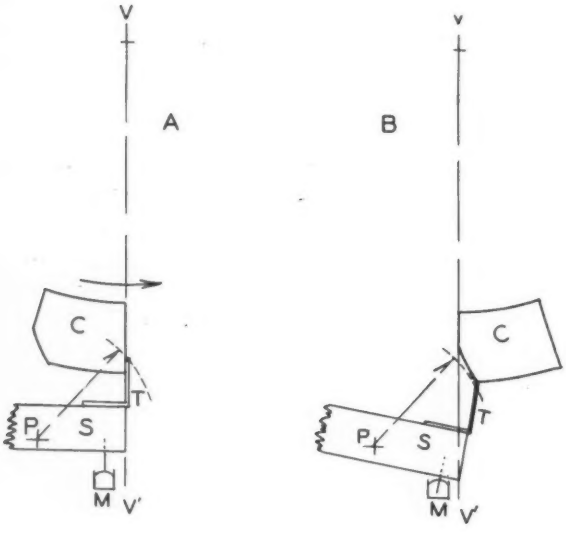


Fig. 2. Cam design. A, situation at beginning of reverse part of cycle. V-V', critical line; P, pivot of switch-block S; T, trip; M, mercury pool on reversing side; C, cam. B, situation at end of reverse part of cycle

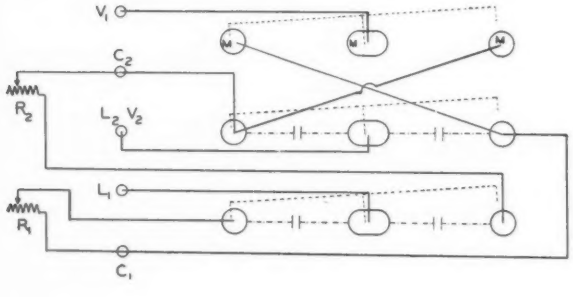


Fig. 3. Wiring diagram of switch-block. Binding posts L_1 and L_2 for line to condenser; V_1 and V_2, voltmeter leads; C_1 and C_2, cell leads; M, mercury pools; R_1 and R_2, rheostats

Mechanical Timing

(*Continued from page 1223*)

times as fast as the wheel is revolving. Other possibilities will be apparent. This device, however, should be used to attain a shorter cycle than is possible at the top speed of the wheel, as it is not desirable to increase the length of time that the circuit is open by slowing the action of the switchblock more than necessary.

The wiring diagram of the switch mechanism is shown in Fig. 3. The dashed lines represent the wires in the tilting switch-block in its normal position; L_1 and L_2, V_1 and V_2, and C_1 and C_2 are binding post connections for the lines from the generator, the voltmeter leads, and the cell leads, respectively. The variable rheostats R_1 and R_2 control the current in the direct and reverse portions of the cycle respectively. It will be seen that L_1, C_1 and V_1 are the same polarity; i. e., the voltmeter is reversed simultaneously with the current to indicate voltage in the reverse part of the cycle. The set of three mercury pools (marked M in Fig. 3) used to reverse the voltmeter connection V_1 is in a sense superfluous to the operation of the machine. Its purpose is to protect the voltmeter, which may be a low range, sensitive instrument, against the full open-circuit voltage of the generator by breaking it out of the generator circuit at the same time that the cell circuit is opened. Wild fluctuation of the voltmeter needle is also avoided by this means.

The device as described has been operated using currents up to 4 amperes over periods of several hours and up to 9 amperes for shorter periods, without objectionable sparking. In the latter case, oil was placed on top of the mercury.

By using condensers of suitable capacity across the mercury pools handling the line current, as shown by the dot-dash lines in Fig. 3, the use of much higher currents without undue sparking should be possible. They may also have another effect. Placed as indicated, they should be so charged as to reinforce the starting voltage on each side of the cycle and thus help in breaking down residual polarization from the previous part of the cycle. If the breaker points were so designed that one set were known to break circuit first, then only two condensers would be required instead of the four that are shown.

To increase the speed of make-and-break, a change in design is indicated. The tilting switch-block, wired as in Fig. 3, should be without counterweight and be operated by a two-coil solenoid, so that the energization of one coil would snap the block to one position where it would remain until the solenoid current was switched to the other coil. This switching would be accomplished by using a single-pole double-throw switch-block of similar design actuated by the cams on the revolving wheel. By this means the speed of motion of the main reversing block would be independent of the speed of the wheel.

Electronic Timing

(*Continued from page 1222*)

lamp *F* and housing *E* happened to be an assembly taken from an old bomb sight to which was added a cardboard cap having a slit about 1/8 x 1 inch. Any arrangement having a lamp with about the light output of a 10-15-watt household bulb, or even less, will serve admirably. As a matter of fact, tests during construction were made with a flashlight, the lens of which was partially covered with black friction tape to form a slit.

When the apparatus has been assembled and turned on, the two variable resistors should be adjusted until a plate current of about two milliamperes more than is required to actuate relay *Re.1* is obtained when the light beam is interrupted; when the beam illuminates the cell, this current should drop to at least one milliampere below the value at which the relay releases its armature. If the relays chatter, minor adjustments of the resistors will correct the trouble.

The method of laying out the disk to furnish the desired cycle is obvious, but one modification should be mentioned. If it is desired to vary the relative cathodic and anodic periods in a given time interval, then two disks should be prepared, each of which has notches corresponding to half the given time interval. When these are mounted on the motor shaft, it will be seen that by displacing them angularly with respect to each other, any proportion of anodic to cathodic time may be secured within that time interval. If by any chance the anodic period were to be the longer, it would, of course, be necessary to reverse the leads to the contact points of relay *Re.2*.

One version of the completed device is shown in Fig. 4.

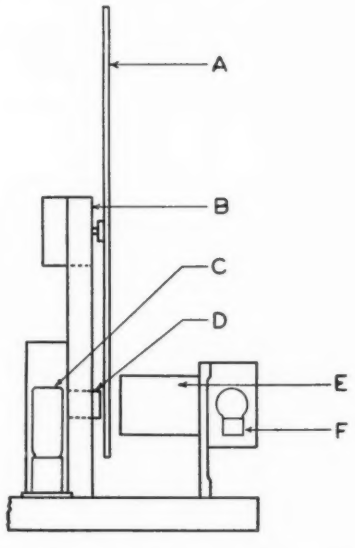


Fig. 1. Schematic drawing of essential parts of timing device incorporated in current reverser

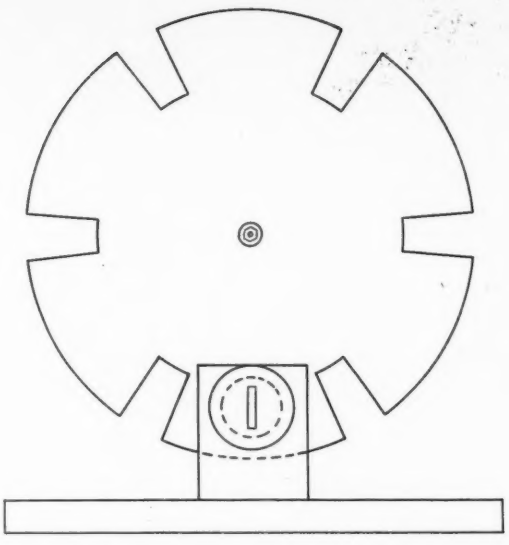


Fig. 2. Schematic drawing of a typical sector disc (Part A of Fig. 1)

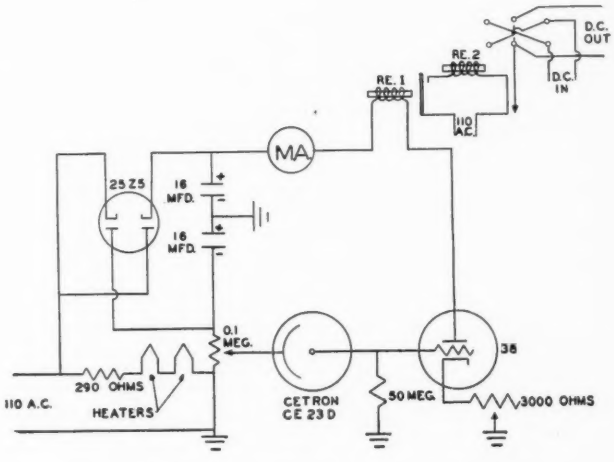


Fig. 3. Wiring diagram of current reverser

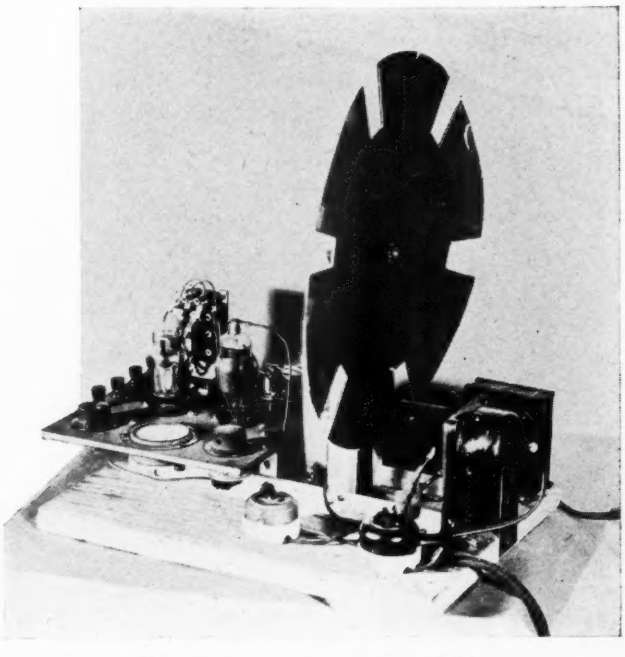
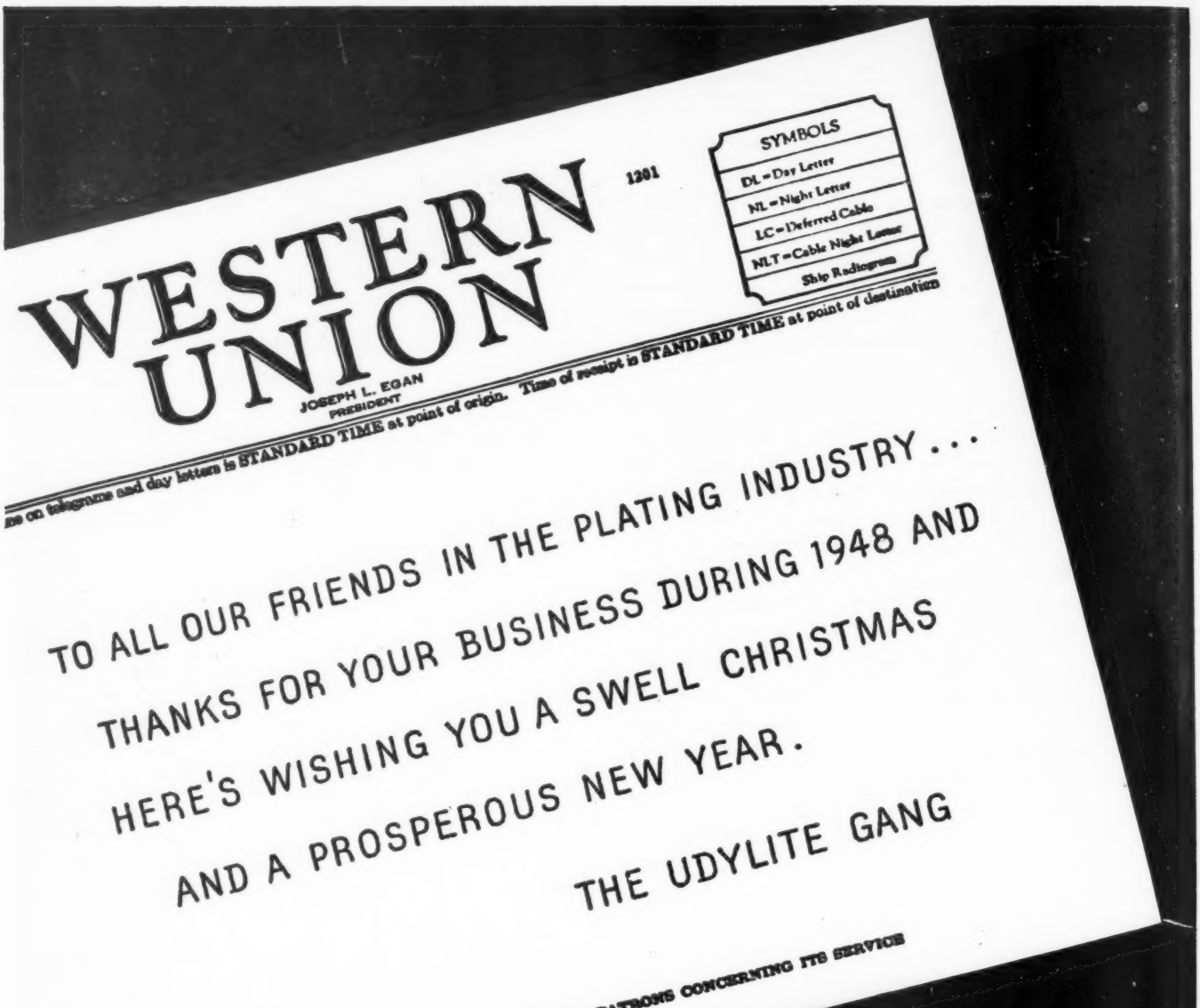


Fig. 4. Current reversing device


WESTERN UNION
1201
SYMBOLS
DL = Day Letter
NL = Night Letter
LC = Deferred Cable
NLT = Cable Night Letter
Ship Radiogram
JOSEPH L. EGAN
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ne on telegrams and day letters is STANDARD TIME at point of origin. Time of receipt is STANDARD TIME at point of destination
TO ALL OUR FRIENDS IN THE PLATING INDUSTRY . . .
THANKS FOR YOUR BUSINESS DURING 1948 AND
HERE'S WISHING YOU A SWELL CHRISTMAS
AND A PROSPEROUS NEW YEAR.
THE UDYLITE GANG
THE COMPANY WILL APPRECIATE SUGGESTIONS FROM ITS PATRONS CONCERNING ITS SERVICE

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PIONEER OF A BETTER WAY IN PLATING . . .

RECENT ELECTROPLATING ACTIVITIES

A. S. T. M. Committee B-8 Reports on Tests and Specifications

Committee B-8 of the American Society for Testing Materials with its subcommittees and their working sections held its annual meeting on October 13 and 14 in Hotel Pennsylvania, New York City in conjunction with the Fall Meeting of the Electrochemical Society. The work of this committee, under the chairmanship of Mr. C. H. Sample of The International Nickel Company, has now reached such proportions and importance that only with careful planning can it take care of all its business in two full working days.

The Committee adopted, subject to letter ballot, a new Tentative Recommended Practice for Preparation of High-Carbon Steel for Electroplating which had been prepared by a working section, of Sub-committee IV, under the chairmanship of Dr. R. M. Wick of Bethlehem Steel Company. This practice outlines the steps that are necessary for maximum adhesion of plated coatings and minimum hydrogen embrittlement during plating. It will serve as a companion practice to the Recommended Practice for Preparation of Low-Carbon Steel for Electroplating, B-183, and for Chromium Plating on Steel for Engineering Use, B-177, both of which are up for re-study. Several other Recommended Practices are in various stages of study or writing, namely on preparation for plating of stainless steels, zinc base die castings, aluminum and its alloys, and copper and its alloys.

The specifications on chromate finishes on zinc, B-201, was changed in several respects by Sub-Committee V and will be presented to the main committee following letter balloting.

Dr. H. A. Pray of Battelle Memorial Institute reported on the outdoor exposure tests carried on by Sub-committee II. These included data on corrosion of the steel as measured by weight loss on both sides of stripped panels which had been lead and copper-lead plated and exposed some 4.3 years earlier. Most striking, perhaps, were relatively low rate of corrosion in industrial New York City, relatively high rate in rural State College, Pa., and very high rate in Kure Beach, N. C., a semi-tropical seacoast location. The copper flash undercoating seems to have retarded corrosion under fairly heavy lead coatings but accelerated it under very thin lead coatings.

The same Sub-committee's tests on nickel-chromium and copper-nickel-chromium coatings on high carbon steel have now been going on for about a year and a half. So far they confirm the findings of the preliminary tests, which included low-carbon steel, that copper contributes little if anything to the protection afforded by the nickel. An additional series of tests to explain why is under consideration.

The Sub-committee expects to receive soon a number of specimens of copper-nickel-chromium plated zinc die castings and of wrought brass prepared by A. E. S. Research Project Committee No. 4 on "Effect of Surface Finishing of Nonferrous Base Metals on the Protective Value of Plated Coatings", Dr. George J. Kahan, Project Director. Through a working section under Mr. Fielding Ogburn of National Bureau of Standards it has already taken steps to set up effective rating systems for these specimens. They will probably be exposed in the early part of 1949.

Other exposure projects now being organized include zinc plated and cadmium plated steel panels with various chromate treatments and chromate-treated zinc-plated panels with and without paint systems, sponsored by Sub-committee V under Mr. Marc Darrin of Mutual Chemical Company of America.

Sub-committee III on Conformance Tests, Dr. W. A. Wesley, The International Nickel Company, Chairman, is studying methods for measuring such specification qualities as indentation hardness, adhesion, porosity, lustre, difficult subjects to say the least. Some experimental work is under way in private laboratories on several of these items.

Dr. R. B. Saltonstall of The Udylite Corporation, liaison to Sub-committee III on Spray Tests of Committee B-3 and Secretary of Committee B-8, reported that certain revisions had been made in A. E. S. Designation B-117, Tentative Method of Salt Spray (Fog) Testing.

Electrochemical Society Holds Electrodeposition Symposia

The two last days of the Fall Meeting of the Electrochemical Society, held October 13–16 in Hotel Pennsylvania, New York City, were largely devoted to electrodeposition subjects. The papers presented at the two sessions on the 15th dealt primarily with electroplating, those on the 16th with electrometallurgy.

A number of papers were of considerable interest to electroplaters. Dr. M. L. Holt of the University of Wisconsin and his co-workers gave not less than three papers on tungsten alloy plating, two on plating iron-tungsten and cobalt-tungsten from citrate baths with high efficiency and one describing a "catalytic" reduction theory for the effect of the necessary co-depositing metals, iron, nickel, and cobalt. Chromium seems to belong to the same group according to work at Rensselaer Polytechnic Institute with a chromium-tungsten bath of lower efficiency.

Dr. Colin G. Fink and V. M. Kokras, Columbia University, had studied the electrodeposition of germanium and obtained only flash coatings unless codeposited with copper, another example of the peculiar effect discussed by Dr. Holt.

Three papers dealt with electrowinning of manganese. Of these the one by David Schlain and John D. Prater of U. S. Bureau of Mines on "Electrodeposition of Gamma Manganese" was of special interest because of the high ductility of γ-manganese as compared with α-man-

(*Continued on page 1269*)

a. e. s. research project no. 9

project director:

A. BRENNER

associate:

C. W. JENNINGS

location:

NATIONAL BUREAU
OF STANDARDS
WASHINGTON, D. C.

Acknowledgment is due the Research Committee, Dr. R. M. Wick, Bethlehem Steel Company, Chairman; the Research Directing Sub-Committee, Dr. Louis Weisberg, Consulting Chemist, New York City, and B. C. Case, Hanson-Van Winkle-Munning Company, Chairman and Vice-Chairman, respectively; and the Project Committee, Dr. W. Blum, National Bureau of Standards, Chairman; N. E. Promisel, U. S. Navy Bureau of Aeronautics, and C. H. Sample, The International Nickel Company, for their contributions to this project.

Physical Properties of Electrodeposited Metals

I. NICKEL

A Progress Report

I. Introduction

It has long been known that a great variation in the properties of electrodeposited nickel can be obtained by depositing the metal under different conditions[1]. This study is primarily concerned with the correlation of these variations in properties with the conditions of deposition. Information on the properties of electrodeposited nickel is important not only in electroforming, in which process the entire article is deposited, but also as an aid in predicting the performance of nickel plated articles.

Considerable literature is available on the properties of electrodeposited nickel, but often they are not correlated with all the plating conditions. The information in the literature is not evaluated in this paper, and only experimental results obtained in this study are reported. Not all of the observations are recorded in this paper, but only typical examples are given to show various trends. One of the most interesting phases of this research, namely the properties of bright nickel deposits, still remains to be completed. It is expected that a complete report on the physical properties of electrodeposited nickel, along with an analysis of the existing literature, will be ready within about a year.

II. Experimental Procedure

In this study only one condition that might influence the properties of the deposit was varied in each experiment; all other factors were maintained constant. All types of plating solutions had the same concentration of nickel, i. e., $2N$, equivalent to a concentration of nickel o about 60 g/l or 8 oz/gal (Table I). The concentration of boric acid in the sulfate and chloride baths was 30 g/l or 4 oz/gal. Most of the plating solutions were prepared with distilled water and commercial nickel plating salts. Important constituents were determined periodically and their concentrations were maintained within ±2 per cent.

As the effects of small amounts of impurities may be appreciable, an effort was made to eliminate all sources of contamination. Each bath had a volume of 10 to 15 liters (2.5 to 4 gal) and was contained in a rectangular glass battery jar. The plating solutions were heated externally by water baths or internally by quartz-jacketed resistance heaters. The temperature was controlled thermostatically to ±1° C (2° F). The solutions were agitated by motor-driven glass stirrers at a rate sufficient only to maintain a constant temperature throughout the solution. The current was controlled to ±5 per cent. The *p*H was measured periodically during the plating with a commercial glass electrode *p*H meter and was controlled by allowing dilute acid to drip into the baths.

Each solution was purified before use by adding an excess of hydrogen peroxide, raising the temperature to 60° C (140° F), increasing the *p*H to 5.8 by means of a nickel hydroxide slurry, or by barium hydroxide for sulfate-containing baths, adding activated carbon and filter-aid, and filtering. The filtered solution was operated at a current density of 0.5 amp/dm² (5 amp/ft²) for a number of

hours with a corrugated cathode and at 10 amp/dm² (93 amp/ft²) for a few hours. A dummy cathode was used prior to the plating of most test samples.

The anodes, consisting of electrolytic nickel sheet (99.4 per cent nickel), were bagged with double layers of glass cloth, which had been degreased and heated to 450° C (840° F) for one hour.

Pitting, the persistent trouble maker, was eliminated or reduced to a minimum by occasional additions of hydrogen peroxide, usually 0.5 ml of the 30 per cent solution per liter, and frequent filtration and operation at a low current density. The solution was tested to insure the complete decomposition of hydrogen peroxide before any test samples were plated. The metallic impurities in the purified baths were determined by F. Ogburn of this Bureau, using methods developed by A. E. S. Research Project No. 2.

Specimens for physical tests were obtained by depositing nickel in sheet or tubular form. The starting sheets and tubes were cleaned prior to plating by degreasing with an organic solvent, scrubbing with powdered magnesium oxide, and dipping in hydrochloric acid. The sheet specimens were obtained by plating upon both sides of stainless steel or Inconel panels, shearing the edges, and lifting off the deposit. In most cases there was little or no adhesion. The panels, 6 x 15 inches (15 x 38 cm), were located midway between two anodes of similar size, to give a nearly uniform current distribution. Tubular specimens were obtained by depositing on smooth, bright copper tubes, 3/16 inch (5 mm) in diameter and 11 inches (28 cm) long, and subsequently dissolving the copper in a solution of chromic and sulfuric acids. Specimens for measurement were cut from the best portions of the sheet or tube and were at least 0.005 inch (0.13 mm) thick, usually from 0.007 to 0.012 inch (0.18 to 0.30 mm) thick.

The following ranges of plating conditions were used in preparing test specimens. The *p*H was varied over a range of 1.0 to 5.8, the temperature from 10° C (50° F) to 80° C (176° F), and the current density from 0.25 amp/dm² (2.3 amp/ft²) to 50 amp/dm² (465 amp/ft²). The compositions of the baths used are indicated by symbols designating the main constituents or variables, that is, S = Sulfate, C = Chloride. The ratio of sulfate to chloride in the bath is indicated by Roman numeral subscripts, for example, in bath $S_{III}C_I$, three-fourths of the nickel is nickel sulfate and one-fourth is nickel chloride.

III. Properties of Electrodeposits

A. Effect of Thickness

If the property of a deposit varies with thickness and the variation is appreciable, it is important to know if there is a thickness of deposit beyond which the property becomes sensibly constant.

The variation in properties with thickness are especially significant for deposits from the sulfate-chloride bath of the Watts type. Figs. 1, 2, and 3 show the variation of hardness, tensile strength, elongation, and electrical resistivity with thickness. The effect is most pronounced with the thin deposits. A set of specimens, 0.0005, 0.001, and 0.007 inch (0.013, 0.025, and 0.175 mm) in thickness, was heated to 1000° C (1832° F) in vacuo for an hour. Their tensile strengths then showed no variation with thickness, indicating that the differences in the metal as-deposited were caused by differences in the structure of the deposits and not by the thickness as such. These variations in tensile strength, elongation, hardness, and resistivity may be correlated with the grain size of the deposit as shown by photomicrographs of the structure

TABLE I. COMPOSITION OF EXPERIMENTAL PLATING SOLUTIONS

Bath No.	Bath Symbol	Bath Type	$NiSO_4.7H_2O$			$NiCl_2.6H_2O$			H_3BO_3		
			N	g/l	oz/gal	*N*	g/l	oz/gal	*M*	g/l	oz/gal
1	S	All-Sulfate	2	280	38	...	...	..	0.5	30	4
2*	OS	All-Sulfate, Co-free	2	280	38	...	...	..	0.5	30	4
3	$S_{III}C_I$	Watts Type	1.5	210	28	0.5	60	8	0.5	30	4
4*	$OS_{III}C_I$	Watts, Co-free	1.5	210	28	0.5	60	8	0.5	30	4
5*	Na	Watts + Na_2SO_4†	1.5	210	28	0.5	60	8	0.5	30	4
6	NH_4	Watts + $(NH_4)_2SO_4$‡	1.5	210	28	0.5	60	8	0.5	30	4
7	S_IC_I	Sulfate-chloride	1.0	140	19	1.0	120	16	0.5	30	4
8	S_IC_{III}	Sulfate-chloride	0.5	70	9.5	1.5	180	24	0.5	30	4
9	C	All-chloride	...	...	...	2.0	240	32	0.5	30	4
10*	OC	All-chloride, Co-free	...	...	...	2.0	240	32	0.5	30	4
11*	C_X	All-chloride, very acid¶	...	...	...	2.0	240	32	...	..	..
12*	Ac	Chloride-acetate§	...	...	...	1.1	130	17	...	..	..

Note: The symbols in column 2 are to aid the memory in recalling the most important variable in the composition of each bath and have following meanings:

S = sulfate

O before a symbol = cobalt free bath

C = chloride

Ac = acetate

Roman numerals, such as in $S_{III}C_I$, indicate the relative proportion of sulfate to chloride

*Deposits from these baths are being studied, but sufficient data has not been obtained for inclusion in this report

†This bath contained 36 g/l (5 oz/gal or about 0.5 *N*) Na_2SO_4

‡This bath contained 33 g/l (4.5 oz/gal or about 0.5 *N*) $(NH_4)_2SO_4$

¶This bath contained 55 g/l (7.5 oz/gal or 1.5 *N*) HCl

§This bath contained 135 g/l (18 oz/gal or 1.1 *N*) $Ni(C_2H_3O_2)_2.4H_2O$

(Figs. 4A and 4C). In general, the grain size of a deposit from the Watts bath increases with the distance from the basis metal. In contrast, the grain size of a deposit from the all-chloride bath did not vary with the thickness. Its photomicrograph (Fig. 4F) shows a homogeneous structure and no apparent variation in grain size with thickness. To minimize thickness as a variable, tests on deposits should be made on specimens at least 0.007 inch (0.18 mm) thick; the usual range of thickness was from 0.007 inch to 0.012 inch.

B. *Measurements Relating to the Plating Process*

The cathode current efficiencies and the stress in the deposits were measured to learn their relation to the properties of deposits. The cathode current efficiencies were obtained by the increase in weight of a cathode consisting of a gold rod. A stop watch and calibrated ammeter were used for measurements of time and current. In addition, a qualitative measure of the cathode efficiency was obtained, on the assumption of 100 per cent anode efficiency, from the observation of the amount of acid which was added to maintain a constant *p*H in the bath during plating.

The cathode efficiencies of most baths with a *p*H of 3 or higher were 99 to 100 per cent. As the *p*H was lowered from 3 to 1.5, the efficiencies dropped to about 90 per cent. The effect of current density on cathode efficiency at 55° C (131° F) was not significant except above 25 amp/dm² (230 amp/ft²) or below 1 amp/dm² (9 amp/ft²). At 10° C (50° F) this effect was significant as shown by Fig. 5. One case was observed in which the apparent cathode efficiency was 102 per cent; deposits from this bath had numerous inclusions and a high oxygen content (Fig. 4G).

The stress in deposits was measured during deposition with a spiral contractometer which was calibrated by the coiling or uncoiling of the spiral with known forces. The results given in this paper are for a thickness of nickel of 0.0003 inch (0.008 mm). The effects of stress were important in our tests because, during plating, stressed deposits would crack and pull away from the stainless steel starting-sheet or warp so badly that the current distribution was not uniform. The adhesion of nickel to polished stainless steel is generally poor. Some deposits on copper tubes would crack when the copper was dissolved, leaving fragments instead of a tube. The stress in the deposits was always tensile and varied from 13,000 to 80,000 lb/in² (910 to 5600 kg/cm²). The lowest stress was contained in a deposit from Bath 3 ($S_{III}C_I$) operated at 55° C, 5 amp/dm² and *p*H 3.0. The highest stress was obtained from the same bath operated at 55° C, 5 amp/dm² and *p*H 5.8. Increasing the *p*H of a sulfate-chloride bath from 1.5 to 5.0 first caused a decrease, then an increase, in the stress of the deposits, with a minimum at a *p*H of about 3.0.

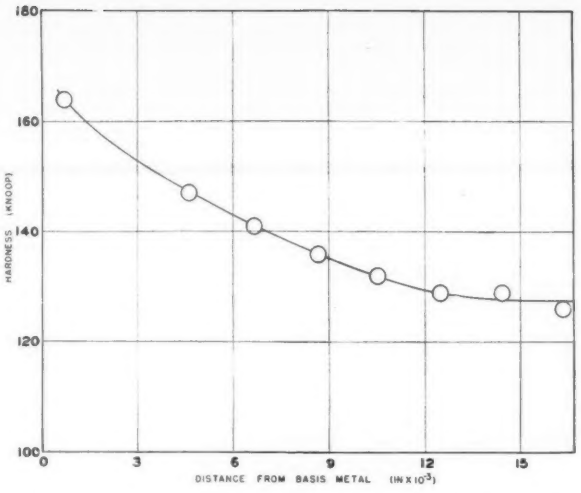


Fig. 1. Variation in hardness of nickel deposit with position of indentation on cross section. Bath 3 ($S_{III}C_I$) at 55° C (131° F), 5 amp/dm² (46 amp/ft²), and pH 3.0

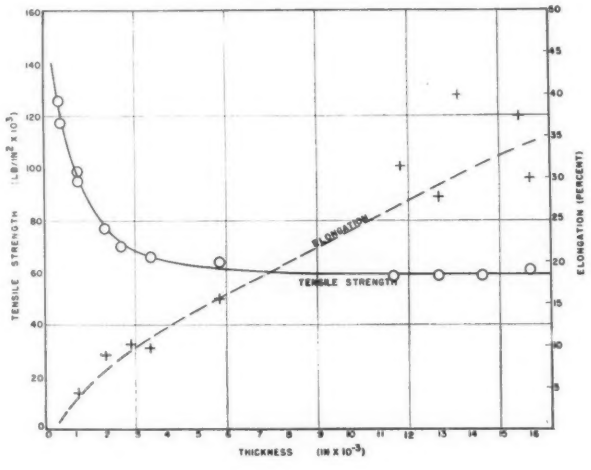


Fig. 2. Variation of tensile strength and elongation with thickness of nickel deposit. Bath 3 ($S_{III}C_I$) at 55° C (131° F), 5 amp/dm² (46 amp/ft²), and pH 3.0

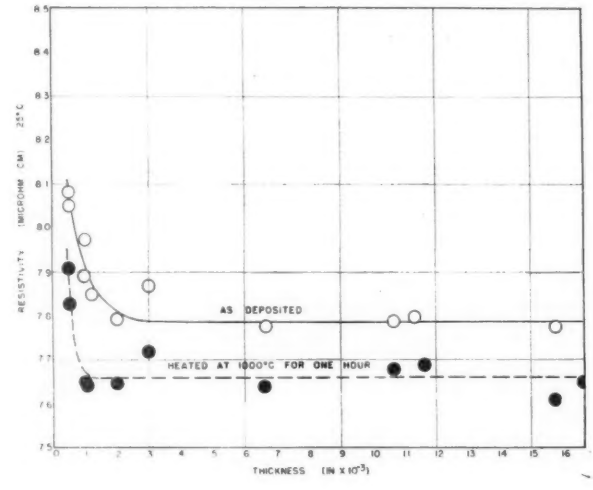


Fig. 3. Variation of electrical resistivity with thickness of nickel deposit. Bath 3 ($S_{III}C_I$) at 55° C (131° F), 5 amp/dm² (46 amp/ft²), and pH 3.0

C. *Physical Properties of Deposits*

1. Hardness. The hardness of the nickel deposits was measured on a Tukon Tester with a Knoop diamond indentor and a 200-gram load. The deposits were usually in the form of nickel plated copper tubes, which were mounted in Bakelite and polished prior to testing. The indentations were made in the center of a cross section of the deposit. The values reported represent an average of at least 3 measurements and are accurate to about 10 hardness units. These measurements were made by Irene C. Minor and S. Del Popolo of this Bureau.

The nickel as deposited varied in hardness from 130 to 430 on the Knoop scale. Deposits from Bath 3 ($S_{III}C_I$) had a

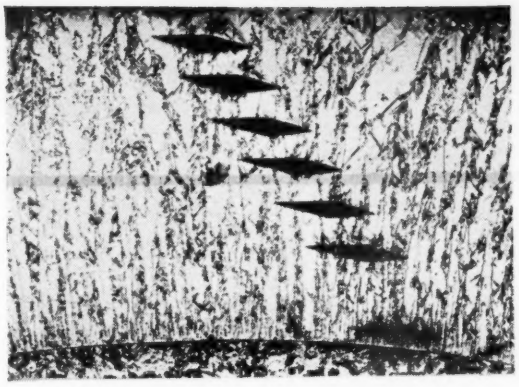
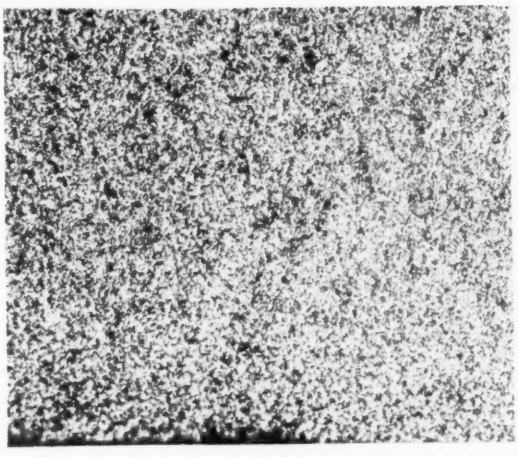
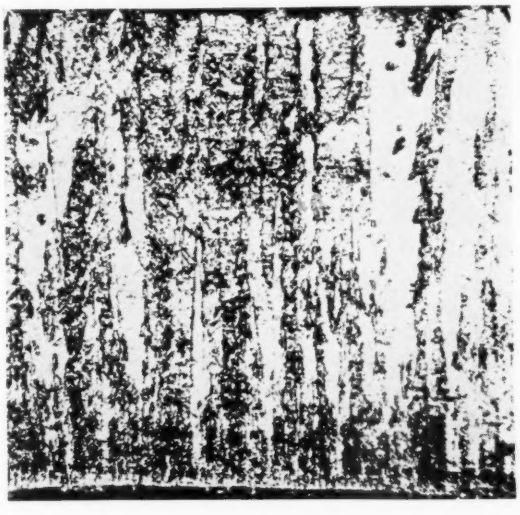


Fig. 4. Photomicrographs of nickel deposits

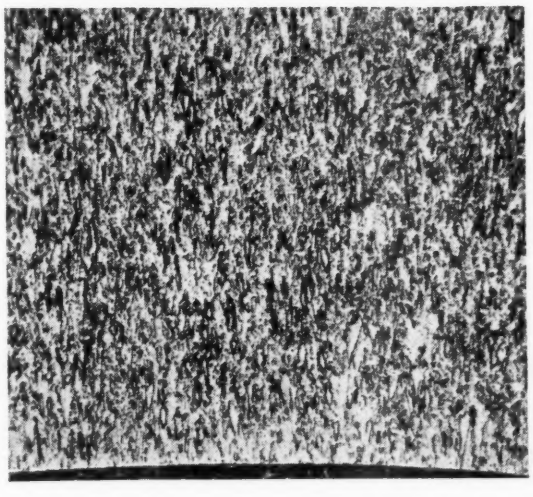
(4a) Bath 3 ($S_{III}C_I$) at 55° C (131° F), 5 amp/dm² (46 amp/ft²), and pH 3.0. X100. Knoop indentations on a cross section



(4b) Bath 1 (S) at 55° C (131° F), 5 amp/dm² (46 amp/ft²), and pH 1.5. X250. Note the homogeneous fine-grained structure



(4c) Bath 3 ($S_{III}C_I$) at 55° C (131° F), 5 amp/dm² (46 amp/ft²), and pH 3.0. X200. Note the columnar structure in comparison with (4b)



(4d) Bath 7 (S_IC_I) at 55° C (131° F), 5 amp/dm² (46 amp/ft²), and pH 3.0. X200. Note the finer-grained structure compared to (4c), illustrating the effect of an increase in the proportion of nickel as nickel chloride in the plating solution

minimum hardness at a *p*H of 3 to 4, as shown in Fig. 6. For current densities of 2 or 5 amp/dm² (19 or 47 amp/ft²), harder deposits were obtained at the higher end of the *p*H range than at the lower. For example, deposits produced at a *p*H of 5.5 were much harder than those produced at 1.5 and both were harder than those produced at the minmum point of *p*H 3 to 4.

The *p*H of 3 seems to be a critical one for the Watts type solution, as deposits from a bank of this *p*H show a minimum hardness at a certain current density and temperature. Deposits from Watts baths of *p*H 1.5 and 5.0 do not show this minimum. The variation of hardness with current density is shown in Fig. 7. The hardness was a minimum at about 4 amp/dm² (37 amp/ft²) for the deposits from baths 3 ($S_{III}C_I$) and 7 (S_IC_I).

As the ratio of nickel chloride to nickel sulfate in a bath was increased, the deposits obtained at 55° C and 5 amp/dm² increased in hardness (Fig. 8). As the temperature of the bath was increased, the deposits obtained from the Watts type bath (at a *p*H of 1.5 and 5.0 at 5 amp/dm²) decreased in hardness, the decrease being greater for the lower-*p*H deposits (Fig. 9A). Deposits plated at a *p*H of 3.0 had a minimum hardness at 55° C (131° F).

2. Tensile Strength. Measurements of tensile strength, elongation, and Young's modulus were made on sheet deposits by A. Stang of this Bureau. The specimens were machined to the Bureau of Standards' specifications for thin sheet material, that is, a 2-inch gage length and a ½-inch reduced width. This is a slight modification of A. S. T. M. Designation E 8–46. The cross sectional areas were determined from measurement of the weight, length, and density.

The tensile strengths obtained for electrodeposited nickel varied from 56,000 to 160,000 lb/in² (3900 to 11,000 kg/cm²). Deposits from baths 3 and 6 ($S_{III}C_I$ and NH_4) decreased, then increased in tensile strength as the *p*H of the bath was increased from 1 to 5.5 (Fig. 10). The minimum occurred at a *p*H of 3 to 4. Much higher tensile strengths were obtained at the high end of the *p*H range than at the low end. The tensile strength of deposits from the sulfate-chloride baths (55° C and 5 amp/dm²) increased as the proportion of nickel present as nickel chloride was increased from 25 to 100 per cent (Fig. 11). For deposits obtained from the Watts type bath, ($S_{III}C_I$), at a *p*H of 1.5 and 5.0 and 5 amp/dm² (46 amp/ft²), an increase in solution temperature resulted in a lower tensile strength (Fig. 9B). Deposits ob-

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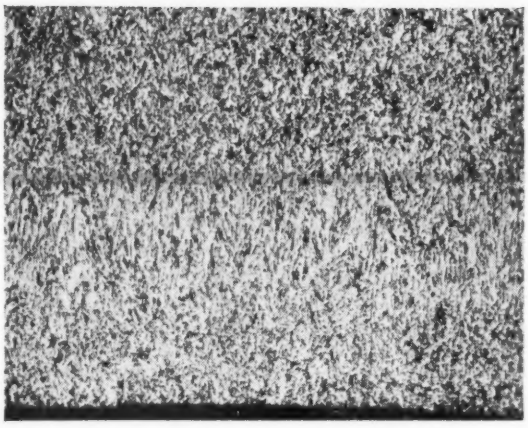
tained at a *p*H of 3.0 showed a minimum in tensile strength at 55° C (131° F) as the temperature was increased from 30 to 80° C (86 to 176° F). This parallels the minimum obtained when the hardness is plotted against the temperature of the solution (Fig. 9A). If the hardness of deposits is plotted against their tensile strength, a linear relationship is obtained (Fig. 12).

3. Elongation. Elongation, a property that indicates the ductility of a metal, was determined by the increase in length of an initial 2-inch gage-length after rupture of the specimen in tension. The results are expressed as a percentage of the initial 2 inches and are accurate to about 10 per cent of the elongation. The range of elongation for all deposits was from 2 to 33 per cent. The elongation generally varies inversely with the tensile strength, i. e., as the tensile strength increases, the elongation usually decreases. As the *p*H of the bath was increased, deposits from the Watts bath exhibited little variation in elongation until a *p*H of 5.5 was reached. Above this *p*H the elongation decreased greatly (Fig. 13). Increasing the amount of nickel as nickel chloride above 25 per cent caused a decrease in the elongation (Fig. 11). Elongation was affected by the presence of pits and cracks in deposits and also by the thickness, so that the results for this property were not as reproducible as for others. The elongation varied with the thickness of the test specimen more than did the tensile strength, and the effect of thickness had to be taken into consideration even for deposits over 0.005 inch thick.

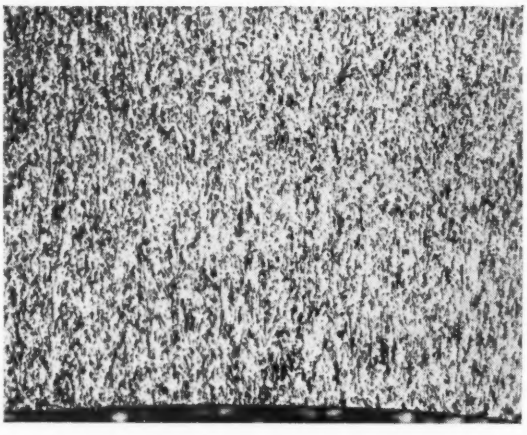
4. Modulus. Young's modulus, or the quotient within the elastic limit of stress to strain, was determined with Tuckerman optical strain gages, having 2-inch gage-lengths and a 0.2 inch lozenge. The values of modulus were calculated from the load and strain values by the method of least squares. A range of 23 to 30 x 10^6 lb/in² (1.6 to 2.1 x 10^6 kg/cm²) was found. Increasing the percentage of nickel as nickel chloride above 25 per cent in the sulfate-chloride baths increased the modulus of the deposit (Fig. 14). Increasing the temperature increased the modulus of deposits from the Watts type bath 3 ($S_{III}C_I$).

5. Fatigue Strength. The strength of nickel deposits in fatigue was determined by subjecting them to a large number of cycles of stress on a Krouse Fatigue Testing machine. The strips were stressed by bending only in one direction from the flat position, so that one side of the strip was always under tension and the other under compression, during the bending. The measurements were made

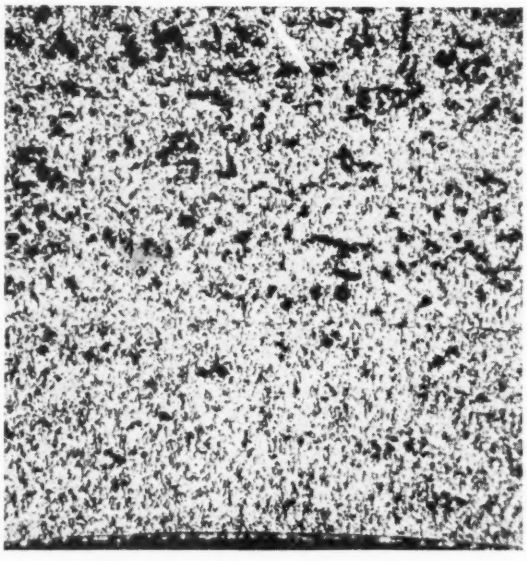
(Fig. 4 continued)



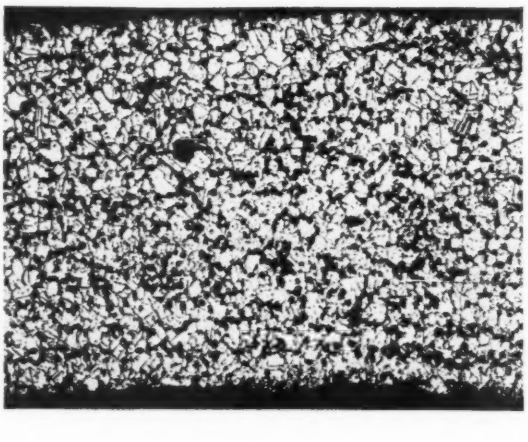
(4e) Bath 8 (S_IC_{III}) at 55° C (131° F), 5 amp/dm² (46 amp/ft²), and pH 3.0. X200. Note the finer-grained structure compared to (4d)



(4f) Bath 9 (C) at 55° C (131° F), 5 amp/dm² (46 amp/ft²), and pH 3.0. X250 Note the finer-grained structure compared to (4e)

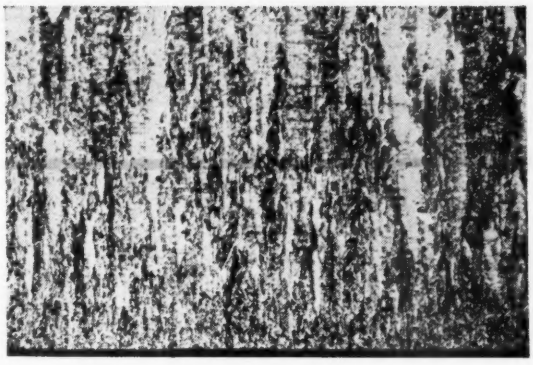


(4g) Bath 9 (C) at 55° C (131° F), 5 amp/dm² (46 amp/ft²), and pH 5.0. X200. Note the presence of inclusions

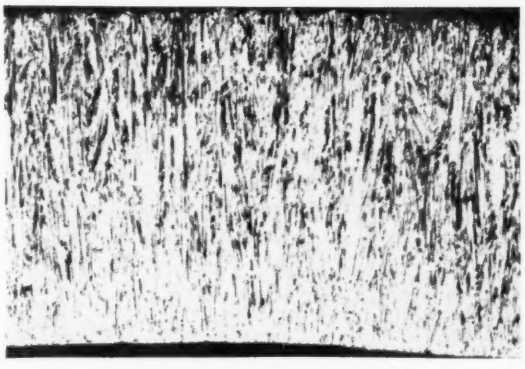


(4h) Bath 9 (C) at 55° C (131° F), 5 amp/dm² (46 amp/ft²), and pH 5.0. X200. Deposit heated to 1000° C (1832° F) for one hour. Note the separation of the grains and the loose structure of this deposit of abnormally low density

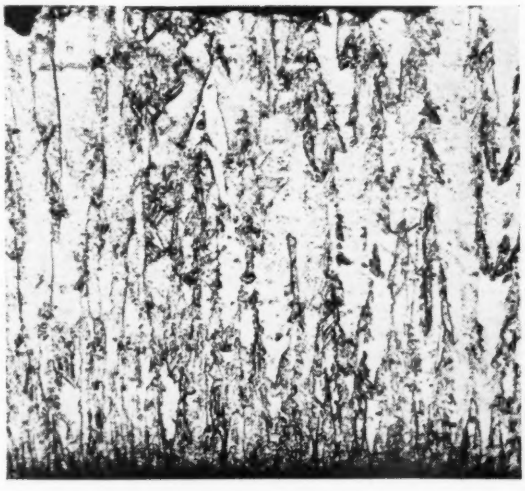
(Fig. 4 continued)



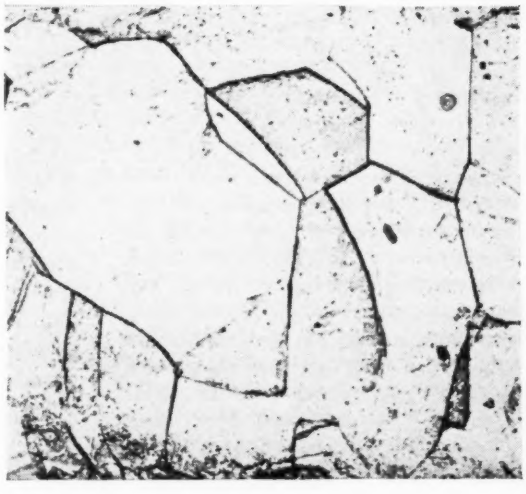
(4i) Bath 6 (NH_4) at 55° C (131° F), 5 amp/dm² (46 amp/ft²), and pH 3.0. X200. Note the similarity to (4c)



(4j) Bath 3 ($S_{III}C_I$) at 55° C (131° F), 0.5 amp/dm² (4.6 amp/ft²), and pH 3.0. X200. The grain size of this deposit is smaller than that of (4c). This structure correlates with the greater hardness as compared to (4c)



(4k) Bath 3 ($S_{III}C_I$) at 55° C (131° F), 25 amp/dm² (230 amp/ft²), and pH 3.0. X200. Note the large grains as compared to (4j) and the similarity of this structure with that of (4c)



(4l) Bath 3 ($S_{III}C_I$) at 55° C (131° F), 5 amp/dm² (46 amp/ft²), and pH 3.0. X250. Deposit heated at 1000° C (1832° F) for 1 hour. Note the equiaxial grains as compared to the columnar grains of (4c)

by J. A. Bennett of this Bureau. Deposits from a Watts type bath (55° C, 5 amp/dm², *p*H 3.0) had a higher endurance limit when the bright side (the one next to the basis metal) was stressed in tension than when the rough side was in tension. The endurance limits were 37,500 and 30,000 lb/in² (2600 and 2100 kg/cm²), respectively. Also, the shape of the curves of fatigue strength plotted against the number of cycles differed, depending upon which side of the deposit was stressed in tension.

6. Density. The density of nickel deposits was determined by weighing tubular specimens, 3 inches (7.5 cm) long and 3/16 inch (5 mm) in diameter, in air and in a heavy liquid (tetrabromoethane) of known density. The accuracy was about 1 part in 500. Only a small variation (8.84 to 8.90 g/cm³) in density was found for nickel as deposited.

7. Resistivity. The electrical resistivity of an electrodeposit is an index of its purity and structure. It is sensitive not only to the type and quantity but also to the distribution of the impurities. The resistivity of nickel deposits was measured by comparing the potential drop across a known resistance (0.001 ohm) with that across a nickel deposit of known dimensions (tube or sheet) in a series circuit. Separate contacts to the deposit were used for the current and the potentiometer leads. For the latter, knife edges 2 inches apart were used and a potential balance was obtained with a sensitive potentiometer and galvanometer, so that contact resistance was eliminated. Small temperature corrections, using a temperature coefficient of resistivity of 0.0066/°C, were made in order to convert all results to 25° C. The reproducibility of measurements was within 1 per cent. To avoid the effect of thickness mentioned earlier, all specimens measured were at least 0.005 inch (0.13 mm) thick.

The range of resistivity of all types of deposits was 7.7 to 9.2 microhm-cm at 25° C. The resistivity of deposits from the Watts type bath 3 ($S_{III}C_I$), operated at 55° C, decreased rapidly as the current density of deposition was increased from 0.5 to 5 amp/dm² (5 to 46 amp/ft²). Beyond 5 amp/dm² there was little change in resistivity (Fig. 15). The cobalt content of the deposits varied with the current density, as will be shown later, and the higher resistivity of the deposits obtained below 4 amp/dm² (38 amp/ft²) is probably a result of their higher cobalt content. The variation with *p*H of the resistivity of deposits from the Watts bath follows a pattern similar to the variation of tensile strength and hard-

ness with *p*H, that is, the resistivity decreased and then increased with increasing *p*H, the minimum being at a *p*H of about 3.0 (Fig 16).

8. Magnetic Properties. The magnetic properties of nickel depend on the physical state of the metal and on the presence of impurities. The magnetization curves of electrodeposited nickel were determined by measuring the magnetic inductance of sheet specimens for given field strengths (B vs H), using a Fahy Simplex Permeameter. The measurements were made by P. H. Winter of this Bureau. Fig. 17 shows the variation which may be obtained in the magnetic properties of deposits plated at two different temperatures from the Watts type bath.

A variation such as this may cause an error in the measurement of thickness by magnetic methods. Samples should be annealed at 400° C to bring them to a more uniform magnetic condition[2].

IV. Structure

The microstructure of nickel deposits was studied in the as-deposited and heat-treated conditions, in an effort to learn the causes for the large variations in properties.

Photomicrographs shown in Fig. 4 were of deposits which had been mounted in Bakelite, polished, and etched with suitable reagents to bring out the grain structure, inclusions, and voids. The photomicrographs were taken by S. Del Popolo of this Bureau Deposits from the Watts type bath, 3 ($S_{III}C_I$), showed a columnar structure (Fig. 4C), while deposits from the all-chloride and all-sulfate baths exhibited a more homogeneous and a finer-grained structure (Figs. 4F and 4B). Increasing the percentage of nickel as nickel chloride in the sulfate-chloride bath resulted in finer-grained deposits (Figs. 4C, D, E, F). The finer-grained structure results in an increase in hardness, tensile strength, and modulus, and a decrease in elongation of the deposits.

A finer-grained deposit is obtained from the Watts type bath, 3 ($S_{III}C_I$) at 55° C and *p*H 3.0 at a current density of 0.5 amp/dm² (5 amp/ft²) than at 5 or 25 amp/dm² (47 or 233 amp/ft²) (Figs. 4J, C and K).

V. Composition

Analyses of deposits were made for both metals and non-metals to correlate their presence with variations in the physical properties.

Cobalt, the only metallic constituent present in more than a trace, was determined by a spectrophotometric method, using thiocyanate and acetone as color forming reagents. These results were checked by the polarographic method, after first removing the nickel with dimethylglyoxime. The electrolytic nickel anodes contained 0.6 per cent cobalt; the commercial nickel sulfate, 70.4 per cent; nickel chloride, 1.06 per cent; and nickel acetate, 0.4 per cent The cobalt content of deposits from a Watts type bath, 3 ($S_{III}C_I$) that contained about 0.36 gram of cobalt per liter varied with the plating conditions. More than four times as high a cobalt content was obtained in deposits at 0.5 amp/dm² (5 amp/ft²) as at 5 amp/dm² (47 amp/ft²) (Fig. 18). The effect of temperature on the cobalt content is not great. If the chloride-sulfate ratio is at least 1/3, increasing this ratio does not affect the cobalt content, although it has been shown that other properties vary considerably.

Spectrochemical analyses of deposits for other metallic impurities revealed

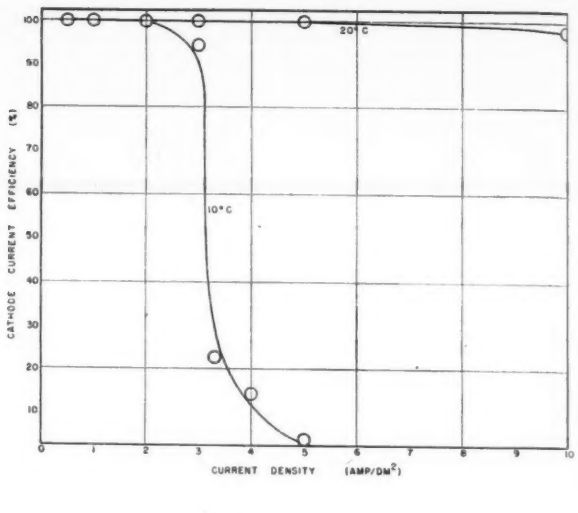


Fig. 5. Effect of current density on cathode current efficiency of nickel deposition. Bath 3 ($S_{III}C_I$) at pH 3.0

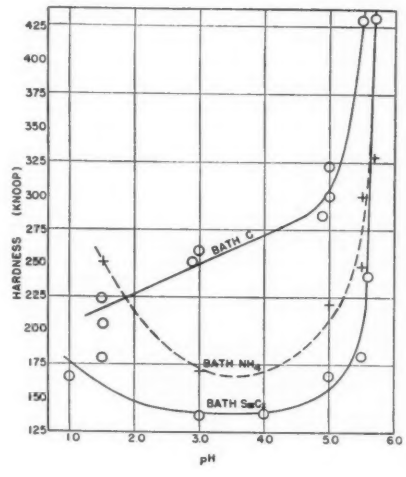


Fig. 6. Effect of pH of plating solution on hardness of nickel deposits. Baths at 55° C (131° F) and 5 amp/dm² (46 amp/ft²)

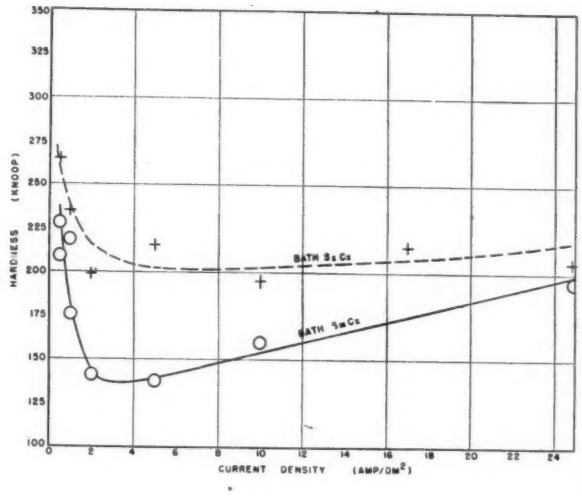


Fig. 7. Effect of current density on hardness of nickel deposits. Baths at 55° C (131° F) and pH 3.0

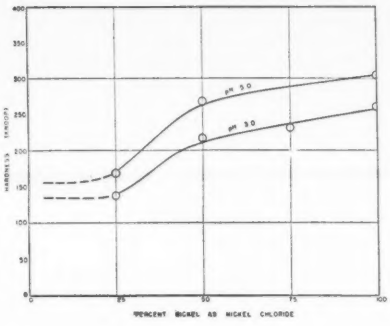


Fig. 8. Effect of proportion of nickel as nickel chloride in plating bath on hardness of nickel deposits. Baths at 55° C (131° F) and 5 amp/dm² (46 amp/ft²)

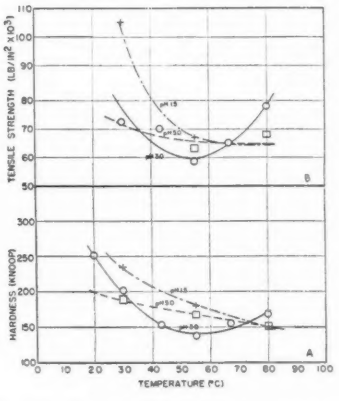


Fig. 9. Effect of temperature of plating bath on hardness and tensile strength of nickel deposits. Bath 3 ($S_{III}C_I$) at 5 amp/dm² (46 amp/ft²)

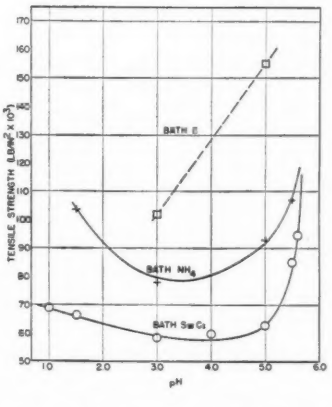


Fig. 10. Effect of pH of plating bath on tensile strength of nickel deposits. Baths at 55° C (131° F) and 5 amp/dm² (46 amp/ft²)

traces (less than 0.001 per cent) of Al, Ca, Cu, Fe, Mg, Mn, Pb, Si, and Sn.

The amount and distribution of non-metallic foreign matter may have a considerable effect on the physical properties of electrodeposits. Of the non-metallic impurities which may be present in a nickel deposit, oxygen, hydrogen, chloride, sulfate, and carbon were determined. Oxygen and hydrogen contents were determined by the vacuum fusion method. The measurements were made by J. T. Sterling of this Bureau. The method involved heating a 0.5-gram sample of nickel at 1600° C in molten iron contained in a graphite crucible. The apparatus was highly evacuated. The hydrogen was given off uncombined and the oxygen as carbon monoxide. The quantity of these gases was determined by noting the decrease in pressure of the system when they were consecutively removed by oxidation and absorption.

Variations in the density, resistivity, and hardness of chromium deposits have been shown to be related to the oxygen content[3]; however, there did not seem to be any such clear-cut relationships for nickel deposits. Other factors such as structure and cobalt content must be taken into consideration.

The hydrogen and oxygen contents of the deposits are given in Table II. The oxygen content of deposits varied from 0.007 to 0.134 per cent; the highest value being for a deposit from the all-chloride bath, operated at 55° C (131° F), 5 amp/dm² (47 amp/ft²), and a *p*H of 5.0. Examination of the microstructure of this deposit showed the presence of numerous inclusions (Fig. 4G). Increasing the *p*H of the Watts type bath, 3 ($S_{III}C_I$) from 1.5 to 5.5 caused an increase in the oxygen content of the deposits (Fig. 19). With increasing current density, the oxygen content of the deposits decreases, then increases.

The hydrogen contents varied from 0.0002 to 0.013 per cent. The hydrogen content was roughly parallel to the oxygen content as shown in the last column of the Table II, although there were a few exceptions. The hydrogen content of deposits was higher from baths operated at *p*H 5.0 than at 3.0 (at 55° C and 5 amp/dm²). The current efficiency of deposition from these baths under these conditions was almost 100 per cent, which means that little hydrogen was given off at the cathode. This, coupled with the fact that oxygen content also increases with the *p*H of the bath, lends support to the idea that most of the hydrogen was present as included basic material.

The chloride in one deposit (55° C, 5 amp/dm², *p*H 5.0) from the all-chloride bath was determined gravimetrically by a micro silver-chloride method and was found to be present to the extent of 0.013 per cent Cl. This deposit was the

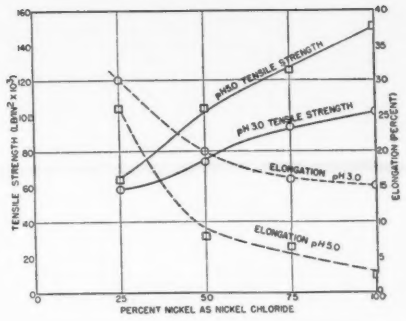


Fig. 11. Effect of proportion of nickel as nickel chloride in plating bath on tensile strength and elongation of 0.008-0.010 inch thick nickel deposits. Bath 3 ($S_{III}C_I$) at 55° C (131° F), and 5 amp/dm² (46 amp/ft²)

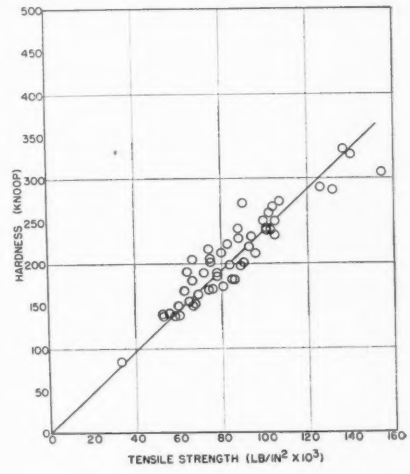


Fig. 12. Relation between hardness and tensile strength of nickel deposits

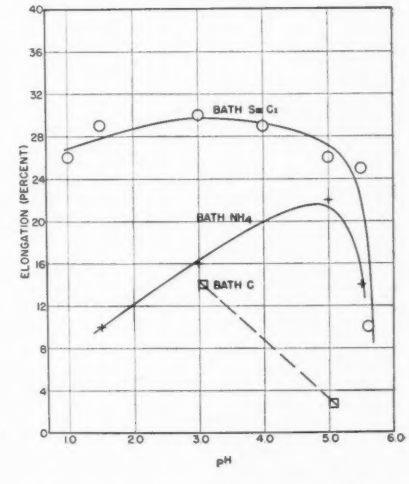


Fig. 13. Effect of pH of plating bath on elongation of 0.008-0.0010 inch thick nickel deposits. Baths at 55° C (131° F) and 5 amp/dm² (46 amp/ft²)

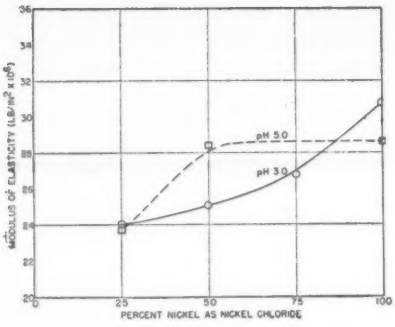


Fig. 14. Effect of proportion of nickel as nickel chloride in plating bath on Young's modulus of elasticity of deposit. Baths at 55° C (131° F) and 5 amp/dm² (46 amp/ft²)

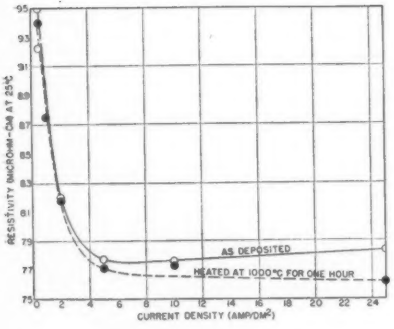


Fig. 15. Effect of current density on electrical resistivity of nickel deposits. Bath 3 ($S_{III}C_I$) at 55° C (131° F) and pH 3.0

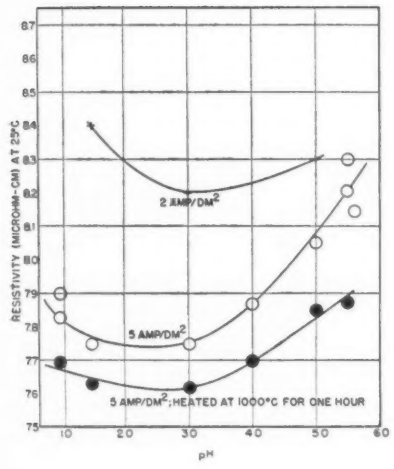


Fig. 16. Effect of pH of plating bath on electrical resistivity of nickel deposits. Baths at 55° C (131° F)

one which also had the largest oxygen content.

A few deposits were analyzed gravimetrically for sulfate but none was detected.

Carbon, determined by a combustion method similar to the method used for carbon in steel, was found to be less than 0.01 per cent in a deposit from a chloride-acetate bath (Bath Ac).

VI. Effect of Heat Treatment

In order to learn more of the structure and composition of deposits, specimens were heated in vacuo for one hour at various temperatures. Some of the properties of the deposits after heat treatment were very different from those of the metal as-deposited. After heating at 1000° C all deposits were recrystallized and their hardness was about 85 Knoop regardless of the bath or conditions of deposition. Deposits from the Watts type bath 3 (operated at 55° C, 5 amp/dm² and *p*H 3.0) had a tensile strength of 33,000 lb/in² (2300 kg/cm²) and an elongation of 30 per cent after heating to 1000° C for one hour. A photomicrograph of the structure of this deposit (Fig. 4L) shows the large equiaxed grains associated with the annealed material.

Interesting variations in the density and resistivity of nickel deposits were obtained after they had been heated in vacuo for one hour at various temperatures (Figs. 20 and 21). For each curve the same sample was heated successively at each temperature and measurements were made, so that there was an accumulative effect of heating. Deposits from baths containing sulfate (1, 3 and 6; or S, $S_{III}C_I$ and NH_4) showed little or no variations in density or resistivity after being heated for one hour at 1000° C. However, with the deposits from the all-chloride bath, considerable variations in density and resistivity were observed. The deposit from the all-chloride bath (*p*H of 5, 55° C and 5 amp/dm²) decreased 10 per cent in density and increased 25 per cent in resistivity when the sample was heated at temperatures up to 1400° C (2552° F). For a deposit obtained at a *p*H of 3 from the same bath, the variation was not so marked. An increase in the length of a tubular deposit was noted, indicating that the linear expansion of the deposit corresponded to the decrease in density. There was a very slight loss of weight of the deposits after heating at temperatures up to 1000° C. Analyses showed the presence of hydrogen, oxygen, and chlorine in the deposits from the all-chloride bath. The percentages of these elements were much higher in the deposit plated at a *p*H of 5 than in one plated at *p*H 3. This non-metallic material is believed to be present in the form of basic inclusions (see Fig. 4G). Photomicrographs of the deposit obtained at *p*H 5 taken after heating at 1000° C

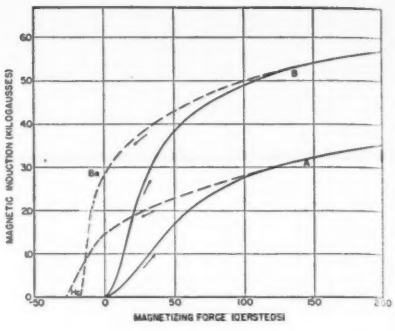


Fig. 17. Typical magnetization curves for nickel deposits. Bath 3 ($S_{III}C_I$) at 5 amp/dm² (46 amp/ft²) and pH 3.0; (A) at 80° C (176° F), (B) at 55° C (131° F)

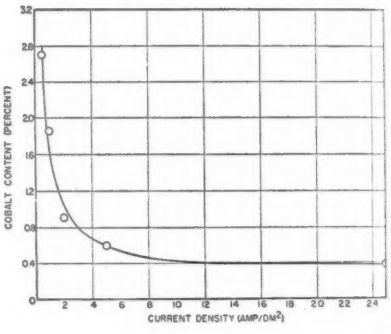


Fig. 18. Effect of current density on cobalt content of nickel deposits. Bath 3 ($S_{III}C_I$) at 55° C (131° F) and pH 3.0

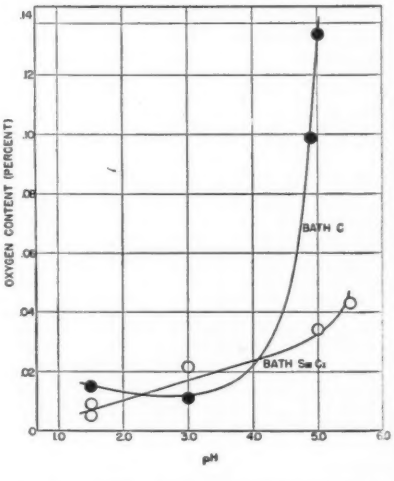


Fig. 19. Effect of pH of plating bath on oxygen content of nickel deposits. Baths at 55° C (131° F) and 5 amp/dm² (46 amp/ft²)

show the presence of a very porous structure (Fig. 4H). Analysis of this deposit before and after heating showed that it had lost 0.080 per cent oxygen and 0.003 per cent chlorine, i. e., an escape of roughly 5 volumes of gas per volume of nickel. All the hydrogen is believed to be liberated at 600° C (1112° F). As the change in density is not significant at this temperature, the expansion effect is not believed to be associated with hydrogen. It is believed that at higher temperatures some decomposition of the included matter within the deposit took place, liberating chlorine and oxygen as gases, which in escaping caused a porous structure.

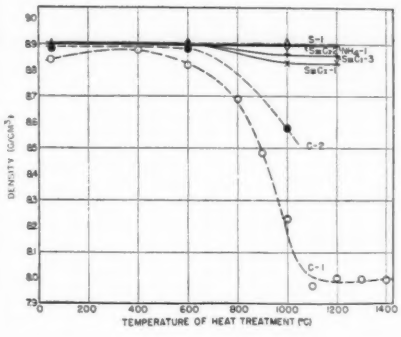


Fig. 20. Effect of temperature of annealing on density of nickel deposits. C-1: bath 9 at 55° C (131° F), 5 amp/dm² (46 amp/ft²) and pH 5.0; C-2: bath 9 at 55° C (131° F), 5 amp/dm² (46 amp/ft²) and pH 3.0; $S_{III}C_I$-1: bath 3 at 55° C (131° F), 0.5 amp/dm² (4.6 amp/ft²) and pH 3.0; $S_{III}C_I$-2: bath 3 at 55° C (131° F), 5 amp/dm² (46 amp/ft²) and pH 3.0; $S_{III}C_I$-3: bath 3 at 55° C (131° F), 25 amp/dm² (230 amp/ft²) and pH 3.0; NH_4-1: bath 6 at 55° C (131° F), 5 amp/dm² (46 amp/ft²) and pH 3.0; S-1: bath 1 at 55° C (131° F), 5 amp/dm² (46 amp/ft²) and pH 1.5

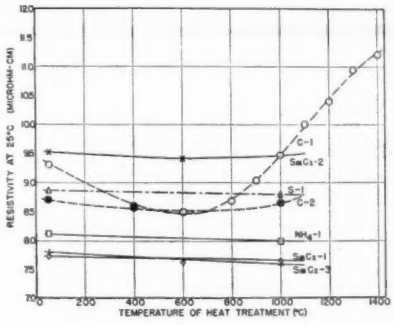


Fig. 21. Effect of temperature of annealing on electrical resistivity of nickel deposits. C-1: bath 9 at 55° C (131° F, 5 amp/dm² (46 amp/ft²) and pH 5.0; C-2: bath 9 at 55° C (131° F), 5 amp/dm² (46 amp/ft²) and pH 3.0; $S_{III}C_I$-1: bath 3 at 55° C (131° F), 0.5 amp/dm² (4.6 amp/ft²) and pH 3.0; $S_{III}C_I$-2: bath 3 at 55° C (131° F), 5 amp/dm² (46 amp/ft²) and pH 3.0; $S_{III}C_I$-3: bath 3 at 55° C (131° F), 25 amp/dm² (230 amp/ft²) and pH 3.0; NH_4-1: bath 6 at 55° C (131° F), 5 amp/dm² (46 amp/ft²) and pH 3.0; S-1: bath 1 at 55° C (131° F), 5 amp/dm² (46 amp/ft²) and pH 1.5

TABLE II. CONTENTS OF OXYGEN, HYDROGEN, AND COBALT IN NICKEL DEPOSITS

Bath No.	Bath Symbol	Depositing Conditions			Analysis			O/H weight ratio
		Temp. ° C	Current Density amp/dm²	pH	Cobalt %	Oxygen %	Hydrogen %	
1	S	55	5	1.5	1.14	0.014	0.0011	13
3	$S_{III}C_I$	30	5	3.0	0.59	0.0092	.....	..
		55	0.5	3.0	2.71	0.032	0.0003	110
		55	5	1.5	0.72	0.0070	0.0005	14
		55	5	3.0	0.58	0.023	0.00018	130
		55	5	5.0	1.01	0.034	0.00082	40
		55	5	5.5	0.5	0.043	0.0074	6
		55	25	3.0	0.38	0.053	0.0048	11
		80	5	3.0	0.71	0.0082	0.00042	20
6	NH_4	55	5	3.0	0.39	0.012	.....	...
		55	5	5.5	....	0.028	0.0023	12
7	S_IC_I	55	5	3.0	0.50	0.018	0.0024	7
		55	5	5.0	....	0.026	0.0035	7
9	C	55	5	1.5	....	0.015	0.0010	15
		55	5	3.0	0.57	0.011	0.0005	22
		55	5	4.9	....	0.099	0.012	8
		55	5	5.0	....	0.134	0.013	10

A number of deposits still had high resistivities after annealing. This is opposite to the behaviour exhibited by chromium deposits, the resistivities of which approached a common value after annealing[3]. A partial explanation of the high resistivity of these nickel deposits lies in their cobalt content, as it is known that the presence of cobalt in nickel will increase its resistivity[4]. (Compare Figs. 15 and 18). The effect of the presence of oxide or similar material upon the resistivity depends upon its distribution, e. g., whether as films about crystal grains or as lump aggregates.

Work in Progress

Deposits of nickel have been obtained from baths 2, 4, 5, 10, 11 and 12 and the measurement of their physical properties is in progress at the present time. The properties of bright nickel deposits, from baths containing organic addition agents, will be studied and compared with the properties of semi-bright and dull nickel deposits. In addition to the properties given in this report, the coefficient of expansion, reflectivity and internal friction and X-ray measurements of nickel deposits will be undertaken in connection with this project.

Acknowledgment

The authors wish to express their appreciation to W. Blum for his interest and guidance and to E. Brittin for his assistance and service in this study.

References Cited

[1] Blum, W., "The Use of Fluorides in Solutions for Nickel Deposition", Trans. Am. Electrochem. Soc. 39, 462 (1921).

[2] Brenner, A., "Magnetic Method for Measuring Thicknesses of Nickel Coatings on Nonmagnetic Base Metals", J. Research Nat. Bur. Standards 18, 576 (1937).

[3] Brenner, A., Burkhead, P., and Jennings, C. W., "Physical Properties of Electrodeposited Chromium", J. Research Nat. Bur. Standards 40, 42 (1948); Proc. Am. Electroplaters' Soc. 34, 32–73 (1947).

[4] Smithells, C. J., "Impurities in Metals", Chapman and Hall, Ltd., London, 1928, p. 116.

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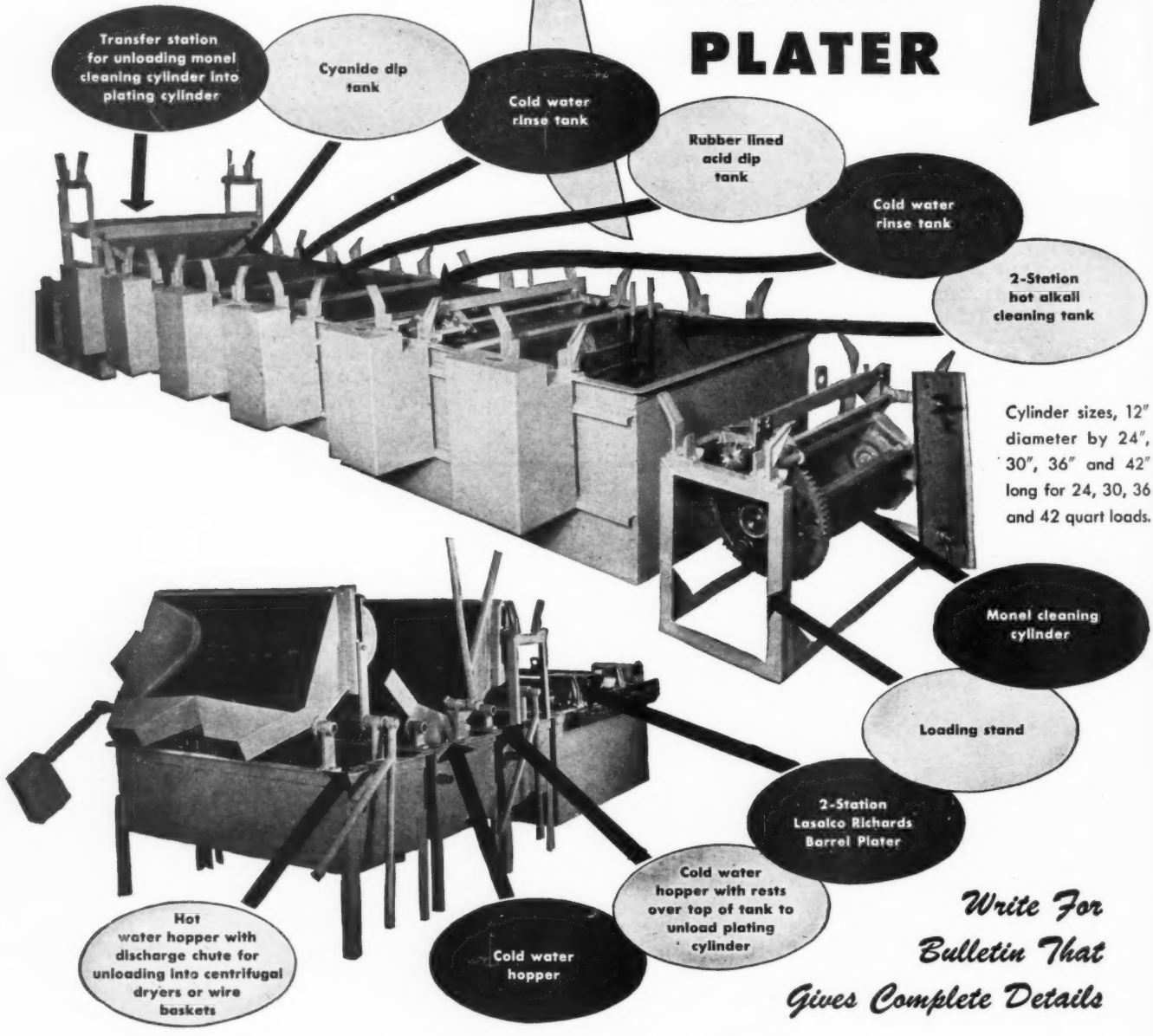
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The Question Box

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Q. 35. What would be a suitable coating on stainless steel tubes to separate the stainless steel and the die or mandril during drawing? The coating should be applied at or near room temperature.

A. While we have had no experience with stainless steel tubes, we believe Bonderite SS (supplied by Parker Rust Proof Company, 2193 E. Milwaukee Avenue, Detroit 11, Mich.) is used as a lubricant in wire drawing and cold heating operations. This coating is porous enough to hold other lubricants if necessary.

Thin electrodeposited coatings of copper, lead, or cadmium (0.00002 to 0.0002 inch thick) are also used as lubricants for wire drawing, cold heading, and spring forming operations. A 70 per cent reduction in area has been obtained with coatings 0.0002 inch thick.

Molten beef tallow or commercial drawing compounds such as Lub-a-tube No. 14 (supplied by Richards Whitfeld, 1743 Carlton Street, Philadelphia, Pa.) have also been used for drawing stainless steel tubing.—K. M. Huston.

Q. 36. Do you know of any cold solution for electrodescaling of stainless steel? What is the best formula for electropolishing this metal?

A. As indicated in K. M. Huston's article in the November issue of Plating, the scale formed on stainless steel is usually tenacious and somewhat more difficult to remove than scale on carbon steel. For this reason cold solutions are not generally employed for removing scale from stainless steel. We do not know of any commercial applications of electrolytic descaling in cold solutions; fumes resulting from electrolytic decomposition of the commonly used descaling solutions would present an occupational hazard difficult to control. The common methods of descaling are described by Huston.

Since, of the number of electropolishing baths now in use, each has operating advantages, it is impractical to refer to any one as being the best. We believe the glycolic-sulfuric acid, citric-sulfuric acid, and phosphoric acid-butyl alcohol baths are most generally employed in commercial operations. Most baths are described by Otto Zmeskal in "Electrolytic Polishing of Stainless Steel and Other Metals", Metal Progress, April, 1945, pp. 729–736.—R. T. Sant.

A. See also the articles by C. H. Faust, "Electropolishing—What Is Its Status Today"? Proc. Am. Electroplaters' Soc. **33,** 49–74 (1946) and by J. Mazia, "Electrolytic Polishing Theory and Practice", Mo. Rev. Am. Electroplaters' Soc. **34,** 937–944 (1947).—Editor.

Q. 37. What kind of heating coils do you recommend for use in bright nickel solutions?

A. The type of heating means varies according to the solution being used. With some bright nickel baths containing organic brighteners, lead coils give satisfactory service. High silicon-iron heat exchangers are recommended with cobalt-nickel bright plating baths. There is a pronounced tendency to use external heat exchangers for modern high-speed solutions rather than metallic heating coils in the tank. Heat exchangers made of special carbon are satisfactory for most bright nickel solutions.—M. B. Diggin.

A. Lead coils cannot be used in nickel solutions containing more than 10 oz/gal nickel chloride or certain organic acids in which the lead is soluble.—Editor.

Q. 38. What causes "rainbows" in chromium plate?

A. "Yellow" chrome, sometimes called "rainbow", usually appears in chromium plate over nickel on low current density areas and is caused by failure to deposit metal in these areas.

To bring the whole article within the bright plate range one must first make certain that bath composition, current density, and temperature have been correctly chosen and should first raise the current density as a possible means of correcting the difficulty. In doing this, one is naturally limited by the tendency to burn or deposit gray chromium on the high current density points.

Before attempting to change the bath, one should make certain that the current is not being lost through failure to provide adequate current carrying capacity in the rack members and that good contact is being obtained between the work and the rack. The next step is to adjust the chromic acid-sulfate ratio upwards, at the same time increasing the current density and, sometimes, the temperature.

Yellow chromium frequently appears around holes or openings and on top edges of pieces being plated, particularly when the back surface of the piece is not being chromium plated. The streaming of the gas and the deplated cathode film upward over the surface is largely responsible for this defect. Changing the position of the piece upon the rack and plugging of holes and other openings with non-conducting material such as a stopper, are used to correct these difficulties.—A. K. Graham.

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Book Review

by DR. HAROLD J. READ,
Associate Professor of Metallurgy
The Pennsylvania State College

ELECTROLYTIC POLISHING AND BRIGHT PLATING OF METALS by S. Wernick, 1948, xv plus 243 pages. Alvin Redman, Limited, Whitfield Place, W. 1, London, England. Price, $6.25 or 30 shillings.

According to the statements on the dust jacket of this book, it was the intention of the author to survey the field of electropolishing and bright plating from both practical and theoretical aspects. Dr. Wernick set for himself a worthy goal, but unfortunately he did not attain it.

If the reader searches first for the theoretical portion of the book, he will be sorely disappointed. As far as bright plating is concerned a total of about six pages scattered here and there through the volume will be found, and electrolytic polishing hardly fares any better. Such items as do appear are not presented in a critical manner. As a review of theory and speculation as to the nature of the processes described, the book is virtually worthless.

The treatment of the practical aspects requires a more lengthy discussion since substantially all of the book is devoted to it. One is struck at once by the haphazard selection of material from the copious literature which was available to the author. In the chapter on bright copper plating, for example, the only cyanide type bath discussed is a weird solution patented by Schlötter and probably never used commercially, whereas not a word is said about true cyanide baths containing addition agents actually used in practice. On turning to the section on bright cadmium plating, one finds that the only solution described is one which was the subject of a very short paper by Mathers and Guest and which has probably never enjoyed any industrial use; the truly important processes based on the Hogaboom or du Pont patents are not mentioned except in the bibliography. The same lack of judicious selection is evident in many other sections of the book. For some strange reason the descriptions of proprietary bright nickel plating solutions used in the U. S. A. have been divorced from the chapter on bright nickel and appear as an appendix. This in itself is bad enough, but the material in the appendix obviously has been culled from the patent literature without appreciation of what is useful and what is not.

There are numerous passages throughout the volume where questionable procedures are recommended in matters other than the bright plating processes themselves. An outstanding example occurs on page 32 where the deposition of copper undercoatings for bright nickel is described. The *p*H range suggested is unsuitable because the bath is poorly buffered in that region, and *p*H indicator papers are not very satisfactory for control of the bath. The author intimates that the anodes may be worked at 60–80 asf, but warns that polarization troubles may be encountered unless the free cyanide and alkali concentrations are carefully controlled. It is surely better practice to keep the anode current density at less than half of the cited values, and avoid the risk of excessive polarization, particularly since there is doubt as to whether it can be consistently prevented by juggling solution composition at anode current densities above 30 asf.

The parts of the book which deal with electropolishing show evidence of the same sort of uncritical selection of material. Even if one felt inclined to rely on the information given, it is difficult to find recommendations applicable to even general problems let alone specific cases which arise in industrial activities. As a test, the reviewer set up a couple of hypothetical problems in electropolishing and searched the book for pertinent information. It is sufficient to say that he was grievously disappointed with the meager amount of definite data and specific recommendations which he was able to find.

There are occasional references to equipment and techniques employed in both electrolytic polishing and bright plating, but they are generalizations that are of no value to the practical plater. For instance, the subjects of filtration and purification of solutions, which are so important in bright nickel plating, are dismissed with a few casual sentences.

The topical bibliography at the end of the book contains 529 entries, almost all of which are very briefly annotated. This is a valuable feature, but it is marred to some extent by errors in both the citations and the annotations, e. g., the patent number given in entry No. 503 is wrong, and in entry No. 126 the descriptive sentence refers to zinc cyanide solutions whereas the paper to which reference is made is concerned wholly with acid zinc solutions. Additional references are scattered through the volume either as footnotes or lists at the ends of the chapters, and notations within a single paragraph may refer to either location—a rather confusing situation. The bibliography, while extensive, is by no means complete, and several important papers have been left out. In many cases the references are incomplete in that page numbers have been omitted; this is particularly true where the papers concerned had been first issued as preprints.

There appears to be no basis upon which this book can be recommended to practical platers, development engineers, or research men.

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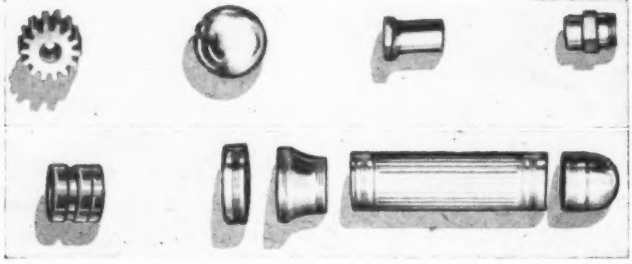

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Abstracts

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Phosphate Treatments for Zinc Surfaces. E. E. Halls. Metallurgia **37**, 299–305 (April 1948).
Gives test results with respect to adhesion over periods up to one year obtained on various forms of zinc to which several different types of phosphate treatment had been applied.

The Deposition of Pure Boron. Part I. A Static Method for the Preparation of Boron Coatings. H. I. Schlesinger, George W. Schaeffer, and Glen D. Barbaras. U. S. Atomic Energy Commission, MDDC-1338, May 24, 1944, 26 pages.
The procedure most frequently used by the authors consisted of heating the object to be coated in a static atmosphere of diborane. By repetition, deposits of the required thicknesses were obtained. Deposition occurs at temperatures between 400 and 600° C. It can be easily adapted to large scale operations. Deposits can be obtained on glass, aluminum, iron, chromium, silver, tantalum, molybdenum, platinum, and tungsten, as well as on the alloys chromel, alumel, and constantan, and may be any desired thickness up to 10 mils. Includes discussion of the chemistry and thermodynamics of the thermal decomposition of diborane and descriptions of preparative and analytical methods.

The Motor-Car vs. The Weather. H. Silman. J. Electrodepositors Tech. Soc. **23**, 121–138 (1948).
A comprehensive review of automotive base metals and the protective, and sometimes also decorative, finishes which are applied to them. There is some misinformation regarding U. S. proprietary copper solutions. Some illustrations of plant equipment are given, including one of a chromium plating barrel. The author considers the best British finishes superior to the best U. S. finishes, but believes U. S. finishes to be more consistent.—LYMAN B. SPERRY.

The Adhesion of Enamel Finishes to Electroplated Cadmium Coatings. E. E. Halls. Metallurgia 75–78 (June, 1948).
Extensive laboratory tests have been carried out on cadmium plated steel panels having various types of enamel finish, in which the cadmium had been given various chemical treatments prior to enameling. The results are summarized in tabular form.

The Determination of Surface Active Agents in Solution. T. Barr, J. Oliver, and W. V. Stubbings. J. Soc. Chem. Ind. **67**, 45–48 (February, 1948).
Describes an accurate direct-titration method for determination of anion- and cation-active compounds

using new partition end points based on the solubility in organic solvents of complexes formed between anion-active agents and methylene blue, and between cation-active agents and bromo-phenol blue, respectively.

Electrodeposition of Speculum. J. W. Cuthbertson. J. Electrodepositors' Tech. Soc. **23**, 143–150 (1948).
Uses of speculum plate are mainly for tableware and light reflectors. The process is covered by U. S. Patents Nos. 1,970,548 and 1,970,549 and also by British patents. Copper and tin anodes are used in parallel but at different voltages. General operation of the bath is discussed. Work now in progress on a commercial process for plating bright speculum is expected to terminate successfully in the near future.—LYMAN B. SPERRY

Practical Aspects of Speculum Plating. W. H. Sawyer. J. Electrodepositors' Tech. Soc. **23**, 151–162 (1948).
Speculum, defined as 40 to 50 per cent tin and balance copper, is similar in appearance to silver but very resistant to tarnish. Necessity for strict technical control of all plating conditions is emphasized. A 0.0003 to 0.0006 inch thickness is recommended since heavier deposits are subject to chipping on impact, due to the brittleness of the alloy. Barrel plating speculum is probably not feasible. Other practical aspects are also well brought out.—LYMAN B. SPERRY.

Polythene and Plating. Electroplating **1**, 302–308, 346 (May, 1948).
Describes a "plastic" material and its use as lining for plating and pickling vats and as coating on those portions of racks and jigs which are not to receive an electrodeposit.

The Chemistry of Copper Etching with Ferric Chloride. C. J. Slunder and L. E. Vaaler. Photo-Engravers Bulletin 37, 26–29 (April, 1948).
Defining the problem and describing how chemical principles can be applied, this article is based on an investigation at Battelle Memorial Institute for Photoengravers Research, Inc.

Notes on Bright Silver Plating. E. W. Wilson. J. Electrodepositors' Tech. Soc. **23**, 139, 142 (1948).
A short paper on the preparation of articles for silver plating, with notes on practical plating with the usual dull plating cyanide bath, with this bath using carbon disulfide as a brightener, and with this bath using as brighteners selenite or selenate with or without an organic condensation product of albumen derivatives and fatty acid (Grunaii 1005). This latter product, a German development, is apparently manufactured by an American company licensed by the Alien Property Custodian.—LYMAN B. SPERRY.

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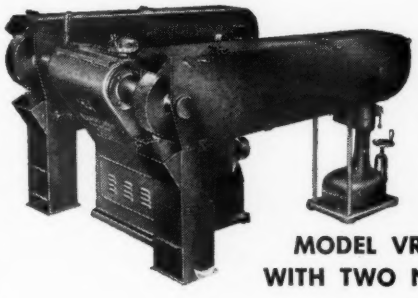
Turn the conveniently located dial and get spindle speed changes from 1500 to 3000 RPM instantly, while lathe is in operation. Model VROL Variable Speed, Ball Bearing, Polishing and Buffing Lathe with a spindle overhang of 8" permits handling of bulky parts without base interference.



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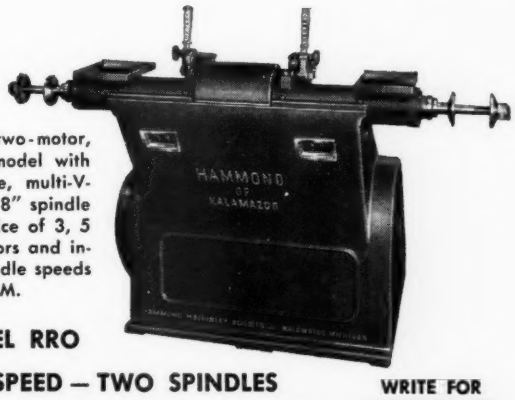

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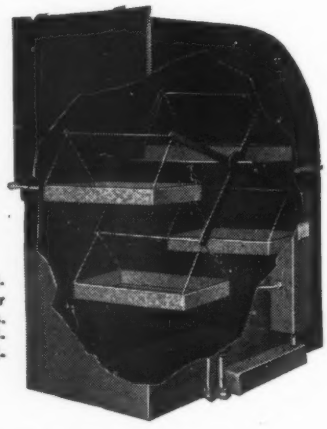

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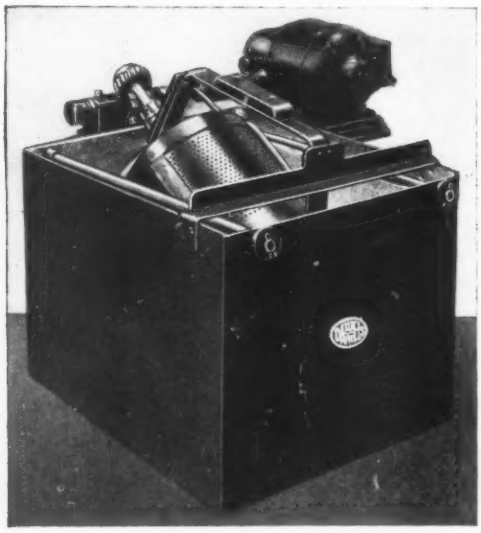

Pictured at the left is the Daniels 8 H Plating Barrel. This barrel was designed for laboratory work, production runs in precious metal plating and for small odd lots that often tie up a plating shop.

Important Features

- **The unit can be used for a wide variety of plating baths.**
- **The cylinder is entirely portable.**
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- **Requires minimum space—18″ by 20″.**

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Patents

By GEORGE B. HOGABOOM
Consultant, New Britain, Conn.

No. 2,449,504, September 14, 1948—Anode—P. R. Pine, assignor to Harshaw Chemical Company.

For many years it has been recognized as desirable that means be devised which would permit the use of electro-sheet without prior melting as the source of nickel in commercial plating.

More specifically stated, an object of the invention is to provide a composite anode comprising an elongated, metallic supporting element adapted to be connected with a suitable source of current.

CLAIM 2. A composite anode comprising a plurality of anode pieces composed of electrolytic metal sheet and spaced approximately parallel bars connected together adjacent their lower ends and having their upper ends bent into hooks adapted to engage over a bus bar whereby to support such composite anode and afford a connection for current supply, said anode pieces being approximately square and two adjacent sides thereof being provided with opposed notches approximately equidistant from one corner, said notches having parallel edges perpendicular to the diagonals of the anode pieces through the corners adjacent to which said notches are located and said notches receiving said bars whereby good contact is provided between the latter and said anode pieces, said corners of said anode pieces being exposed to electrolytic action and serving to shield portions of said bars from such action.

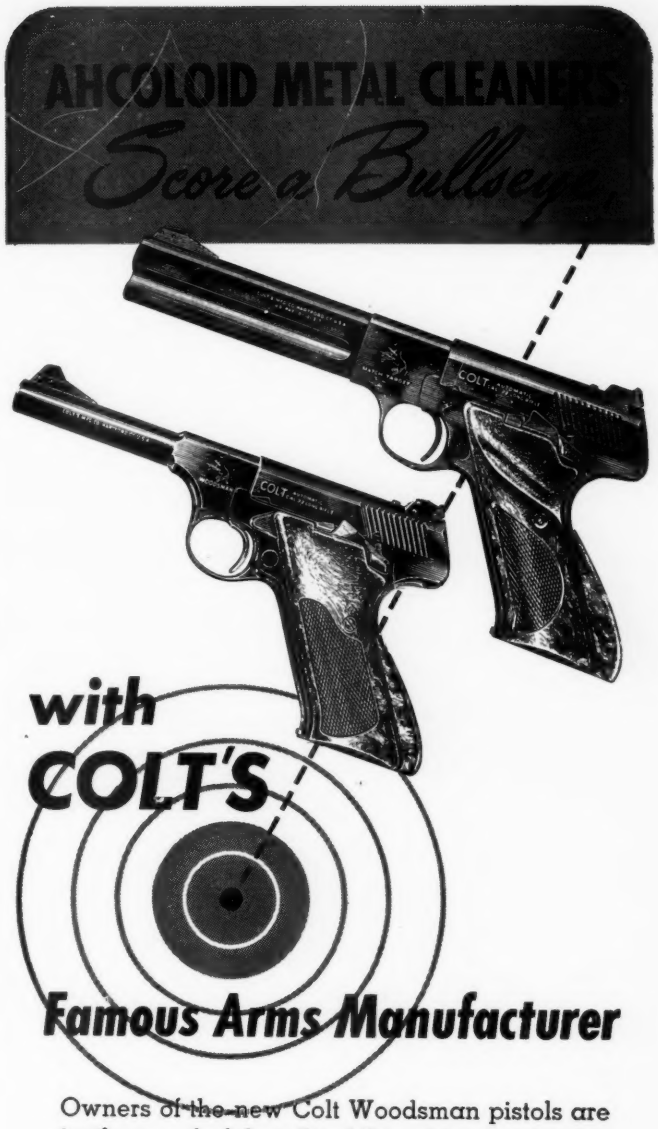
2 claims.

References cited: U. S. Patents 546,483; 867,319; 1,373,693; 1,537,046; 1,549,233; 1,868,052; 2,256,820. British Patent 5,734.

No. 2,450,296, September 28, 1948—Method of Producing Articles Having Fissured Chromium Surface Electrodeposits—Frank Passalacqua (Frank Passal), assignor to United Chromium, Incorporated.

A further control of plateau size may be effected by a heat treatment of chromium electrodeposited according to the Webersinn and Hyner invention.

Heat treatment prior to post treatment of chromium, electrodeposited under conditions to predispose to is the formation of fissure networks, has the advantages (1) of providing a means of controlling the plateau size of fissure networks auxiliary to the means disclosed by Webersinn and Hyner (U. S. Patent 2,430,750), (2) of bringing about greater uniformity of plateau areas formed in the post-treatment that is obtained without the heat treatment, (3) of decreasing the fractioning or crumbling at the edges of plateaus in the mechanical finishing of the chromium surface after post-treatment, (4) of shortening the



Owners of the new Colt Woodsman pistols are justly proud of their Dual Tone blue finish. This new "satin" finish covers areas subject to hand contact and light reflection. It provides added protection against rust and accuracy-killing glare, and also gives a better gripping quality. The master craftsmen at Colt's achieve this surface by using AHCOLOID Metal Cleaners before and after hardening to remove oil and dust from internal and external parts.

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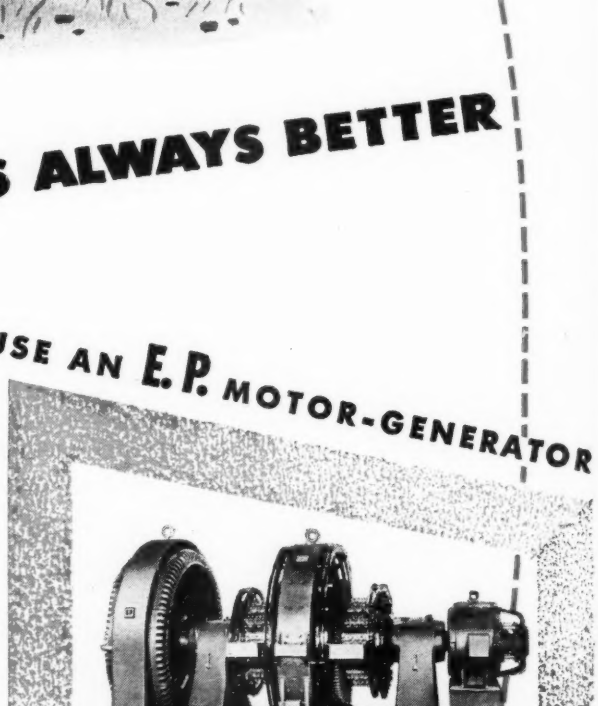

• Endurance, specialized ability and ruggedness . . . these are the three chief differences between the "first stringer" and the "bench-warmer." And they are the main reasons why the E.P. Motor-Generator has been chosen to supply hundreds of thousands of direct-current amperes throughout the metal-working industry for electroplating, electro-cleaning, electrotinning, electrogalvanizing, electro-polishing and anodizing.

Continuous duty for over twenty years is common for an E.P. Motor-Generator. Tailor-made for the specific electrolytic process, it assures economies unmatched by ordinary commercial machines. Unaffected by the corrosive atmospheres common to most electrolytic operations, it requires no special protective equipment. There's no production "time-out" with an E.P. Motor-Generator.

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ASK FOR BULLETIN 202

EP X-41

THE ELECTRIC PRODUCTS COMPANY

1721 CLARKSTONE ROAD CLEVELAND 12, OHIO

time of post-treatment for obtaining a given depth of fissure.

CLAIM. In a method of producing fissured networks in the surface of chromium electrodeposits, heating chromium electrodeposits which are predisposed to the formation of fissured chromium of the "mud crack" or "channel" type of a size greater than 0.008 inch average plateau diameter to temperatures and for times within the ranges

212° F	1¼ hours
350° F	2 hours
500° F	2 hours

and thereafter etching the heat treated chromium electrodeposits at the temperature of the etching bath to develop a fissure network therein, the plateau areas of the networks being reduced to ¾ to ¼ of the size which would be obtained on etching without the previous treatment.

1 claim.

References cited: U. S. Patents 1,745,912; 1,802,463; 1,838,273; 2,048,578; 2,314,604; 2,430,750.

No. 2,450,508, October 5, 1948—Tin Plate Treatment—Charles E. Glock, assignor to Crown Cork and Seal Company, Baltimore, Md.

CLAIM 1. In the method of treating a continuous strip of tin plate in a line wherein the tin coating is electrolytically deposited and then flow brightened, the steps of treating such bright finished tin plate to render the same resistant to the action of foods and sulfur stains comprising subjecting the surface of the flow brightened tin plate to a light rubbing action which does not deteriorate the flow brightened finish, then subjecting the brightened tin plate to an aqueous acid electrolytic bath in which the tin plate is the cathode for from about three to ten seconds, the bath being maintained at a temperature between 170° F and 200° F and a current density at the cathode being about ten amperes per square foot to about 100 amperes per square foot, the bath consisting essentially of about 0.25 per cent ot 5.0 per cent chromic acid and not more than about 0.01 per cent SO_4 radical.

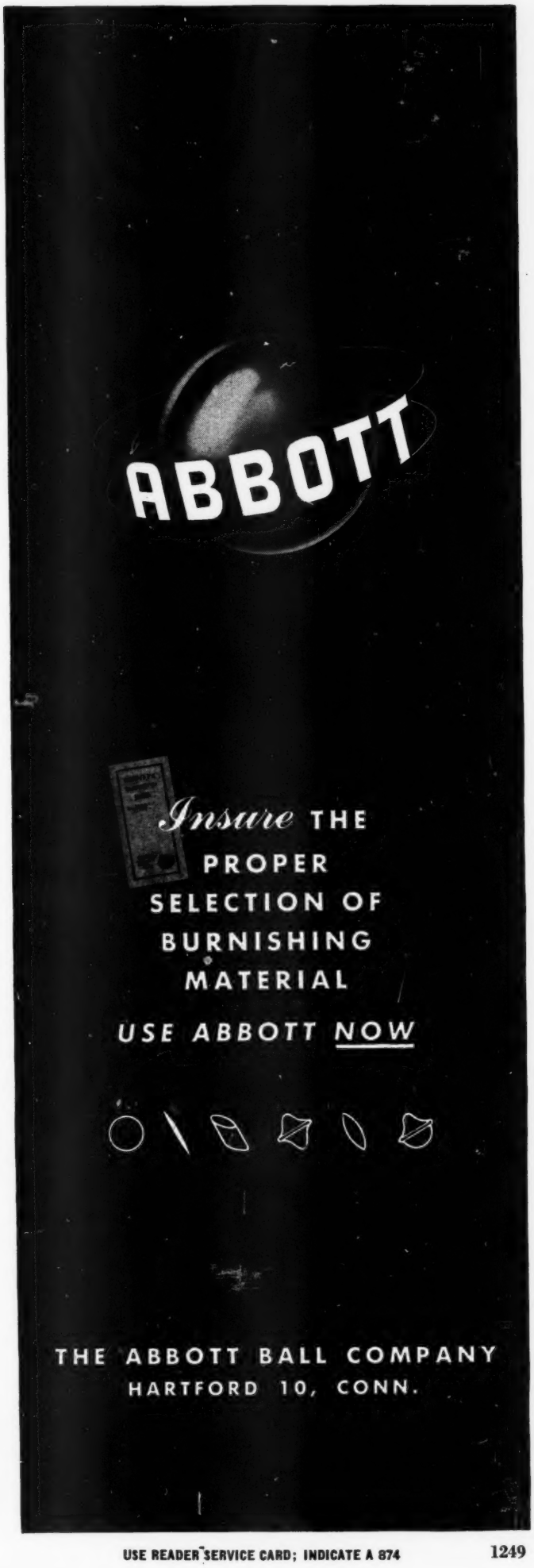
2 claims.

References Cited: U. S. Patents 1,734,706; 1,827,204; 1,827,247; 1,953,998; 1,954,473; 2,215,165; 2,312,076; 2,327,885; 2,424,718. British Patent 558,130. J. Soc. Chem. Ind., Trans. and Comm. 259–265 (December, 1940). Trans. Electrochem. Soc. **84,** 240 (1943).

No. 2,450,509, October 5, 1948—Tin Plate Treatment—Charles E. Glock, assignor to Crown Cork and Seal Company, Baltimore, Md.

Same as No. 2,450,508 except for the composition of the final electrolytic bath:

CLAIM 1 . . . the bath consisting essentially of about 0.3 per cent to 2.0 per cent sodium dichromate and about 1.5 per cent to 6.0 per cent trisodium phosphate.

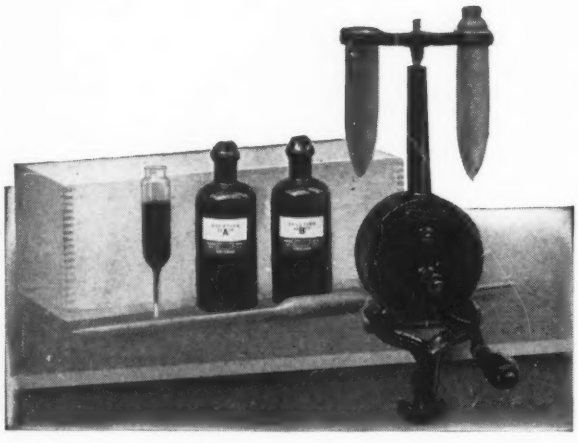


KOCOUR

SULFATE TEST SET

for determining

Sulfates in Chromium Solutions



This apparatus enables anyone to accurately and quickly determine the sulfate content of a chromium plating solution.

For consistently good plating results, the ratio of sulfates to chromic acid must be maintained within very definite limits so that a constant check must be kept.

This is easily accomplished with this equipment and we can also supply sets for quickly ascertaining the chromic acid and trivalent chromium content.

We also manufacture test sets for analyzing other plating solutions, cleansers, pickles, anodizing baths, for determining the thickness of zinc, cadmium, copper and tin deposits and for pH determination.

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No. 2,450,794, October 5, 1948—Electrodeposition of Tin—Elmer F. Harris, assignor by mesne assignments to Carnegie-Illinois Steel Corporation.

Broadly stated, the invention consists in the addition to acid or neutral electrolytes for tin plating, that is those with a *p*H value of 7 or less or those having a maximum upper limit in the *p*H value of 7, of an addition agent which broadens the plating conditions, such as temperature of the bath, degree of agitation and current density, under which satisfactory coatings are secured. The effect of the agent added by the present invention to the plating bath is particularly noticeable in the lower current density ranges, the resulting bath making satisfactory deposition possible at much lower current densities than formerly could be used. As a result, satisfactory coatings are secured even though plating conditions in the bath are not maintained so accurately as was heretofore necessary.

CLAIM 1. The method of electrodepositing tin which comprises providing a tin anode in an electrolyte, making the article upon which the tin is to be deposited the cathode in such electrolyte, the electrolyte consisting of an aqueous solution of the following ingredients:

Tin, g/l	10–60
Phenolsulfonic acid, g/l	35–110
Dihydroxydiphenylsulfone, g/l	1–9
Monobutylphenylphenol sodium monosulfonate, ppm by wt	5–2000

and passing an electric current between the anode and the cathode having a current density of at least 20 amperes per square foot of a cathode in the electrolyte.

CLAIM 4. An electrolyte for deposition of tin consisting of an aqueous solution of 10 to 60 grams per litre of tin, an acid of the group consisting of phenolsulfonic acid, sulfuric acid, fluosilicic acid, benzenesulfonic acid, and nitrobenzenesulfonic acid, the range of acid being 35 to 110 grams per liter for phenolsulfonic acid and the molecular equivalent for the other acids, 1 to 9 grams per liter of dihydroxydiphenylsulfone, and 5–2000 parts per million by weight of monobutylphenylphenol sodium monosulfonate.

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7 claims.

References cited: U. S. Patents 2,195,409; 2,271,209; 2,313,371.

No. 2,450,795, October 5, 1948—Electrodeposition of Tin—E. F. Harris, assignor by mesne assignments to Carnegie-Illinois Steel Corporation.

CLAIM 5. An electrolyte for deposition of tin consisting of an aqueous solution, having a maximum upper limit in the *p*H value of 7, of 10 to 60 grams per liter of tin, 1 to 9 grams per liter of a sulfone of a substance of the group consisting of phenol, cresol, resorcinol and naphthol, 5 to 2000 parts per million by weight of monobutylphenylphenol sodium monosulfonate, and 0.02 to 50 parts per million by weight of phenyl-para-phenylenediamine.

7 claims.

References cited: U. S. Patents 2,195,409; 2,271,209; 2,313,371. Trans. Electrochem. Soc. **80,** 391-392 (1941).

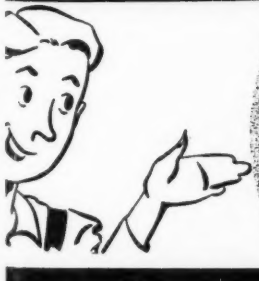
No, 2,452,308, October 26, 1948—Process of Plating Palladium and Plating Bath Therefor—George C. Lambros.

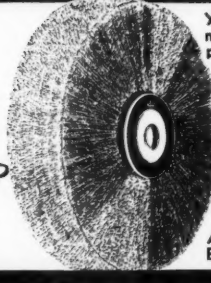
CLAIM 2. A process of electrodepositing palladium which comprises dissolving freshly precipitated dichlorodiamine palladium in an aqueous solution of cyanide of the group consisting of sodium cyanide and potassium cyanide, said solution containing cyanide in the amount ranging from 0.63 to 0.69 grams of cyanide (CN) per gram of palladium in the form of dichlorodiamine palladium, and from 0.5 to 15 grams of palladium metal per liter, and electrolyzing said solution in the presence of said cyanide at a temperature of about 90° C, and replenishing the solution periodically to maintain the palladium content of the solution from 0.5 to 15 grams of metal per liter.

5 claims.

References cited; U. S. Patents 1,962,559; 1,991,995; 2,286,274; 2,355,821. British Patent 408,244. Metal Industry (New York) **26,** No. 8, 356 (August, 1928).

WIRE SCRATCH BRUSHES





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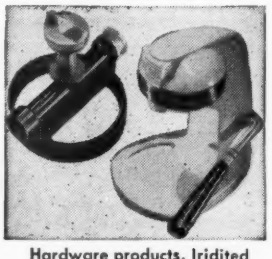

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Equipment & Supplies

E—180. Platers' Microscopes—To meet the need for a more efficient means to determine plate thickness, Hanson-Van Winkle-Munning Company, Matawan, N. J., has arranged with the Bausch & Lomb Optical Company to provide an improved microscope for electroplaters. This model CM is described in its Bulletin EM-102.

Special attention has been given to the vertical illuminator which consists of plane glass and prism reflectors fitted in the same tubular mount. The glass reflector in the unit has been surfaced to increase the efficiency of the illuminating unit. A slotted side tube takes a color filter Polaroid or polarizer and also carries the condenser lens, field and aperture diaphragm. Complete control of incident beam is assured. The Balcote treatment of all air-glass surfaces results in clearer photomicrograph images. Gain in image quality is particularly evident when objects such as cast iron, steel and manganese bronze are studied. For further information, use Reader Service Card.

E—181. Paint Spray Booth—Despatch Oven Company, 600 Ninth Street, S. E., Minneapolis 14, Minn., offers a water-wash Spray Booth for removal and cleaning of paint-laden air which differs in design of the front curtain, which is one of five through which air must travel before it is exhausted. The curtain slopes slightly to permit 56 gallons of water per minute to pass down each foot of curtain without splashing. The headers supplying this flow and two others inside the eliminator section are individually controlled so that the volume can be varied to meet demands. This volume is greater than that required to keep paint from building up on the curtain; even metallic paint does not accumulate to reduce efficiency and require cleaning downtime, it is said.

Axial flow fans provide a minimum of 150 cfm air per square foot of face for removal of overspray. Two headers have orifices along the top which shoot the water against a divider plate to form two water curtains. A settling tank allows washed-out paint to accumulate for easy reclaiming.

E—182. Brush Equipment for Cleaning of Strip—The Rockwell Brush Box, manufactured by W. S. Rockwell Company, 200 Eliot Street, Fairfield, Conn., for continuous cleaning of steel or non-ferrous strip after pickling or cleaning, is of all-stainless steel construction to withstand the corrosive effects of the solution and rusting due to water spray. Strip, either in a single broad width or a series of narrow strips up to 60 inches wide, enters the box and passes over spring-tension wringer-rollers which press out most of the acid and water before they reach the brushes. Other wringer rollers remove water spray before the strip leaves the box.

From the rollers, strip passes between anvil rollers and revolving Tampico fiber or stainless steel brushes. Anvil rollers are driven in the same direction and at the same speed as the strip by the conveyor power supply or by independent motors. The brushes are independently driven in the opposite direction and at a much higher speed, varied to conform with characteristics of the strip. They are oscillated 3 inches by cams to give a two-way motion to the scale removal and to prevent the strip from wearing a "track" in each brush. Tension between brush and strip may be regulated by a visible gauge.

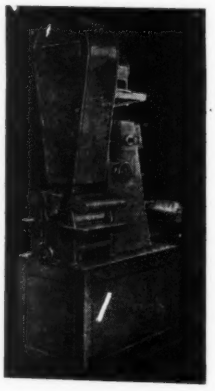
Brushes are easily accessible and may be replaced by lifting out through the top of the box. This unit is also available with two brushes for light cleaning jobs. For further information, use Reader Service Card.

E—183. Combination Blast and Spray Gun — Tornado Combination Blast Gun, manufactured by Engineered Products, Inc., 1224 Speer Boulevard, Denver, Colo., is said to be equally adapted to sand blasting and solvent spraying, thereby improving and simplifying surfacing and cleaning in automotive and industrial fields. Air operated and portable, it is claimed to leave no buffing marks, no grooves or ridges, no scuffed, gouged or uneven surfaces. There are no shafts to break, no wheels to dress and no motors to burn out. It is particularly useful in reaching inaccessible places.

The Tornado Blast Gun may be connected to any air line and is equipped for sand blast operations or spraying solvents or other liquids. The nozzle is easily changed by loosening a retaining nut and slipping another nozzle in place. For further information, use Reader Service Card.

E—184. Automatic Polisher for Flat Stock—The Curtis Straight-O-Matic Polisher, manufactured by the Curtis Machine Corporation of Jamestown, N. Y. and distributed by W. J. Holtmeier, Inc., 71 W. 23rd Street, New York 10, N. Y., is designed for the automatic finishing of flat stock such as carpenter handsaw blades, machetes, and strip steel up to 10 inches wide. It can be used as an individual machine, changing belts for the various grits to be used, or can be used in tandem. It can also be supplied with an inverted head so that both top and bottom can be finished with one pass of the stock. It can also be employed in connection with automatic buffing heads so that a complete operation can be done if desired.

Among the features claimed are a rugged welded steel frame to eliminate



vibration; straight-through arrangement for high speed production which allows feeding manually, by coil unwinding-and-winding machines, or by conveyor or equivalent means; infinitely variable, quickly adjustable feed from 20 to 60 feet per minute; screw adjusted feed rolls that take stock of any thickness up to 1 inch. For further information, use Reader Service Card.

E—185. Combination Deburring Barrel and Separator—Savings of time, labor and floor space are claimed for the Belke Combination Deburring Barrel and Separator, developed by the Belke Manufacturing Company, 947 N. Cicero Avenue, Chicago 51, Ill. It is said to remove burrs from machined parts without affecting close tolerances, to produce a uniform finish, ideal for painting and many types of electroplating, and in preparation for burnishing. The barrel has two compartments permitting two completely independent jobs to be run simultaneously. One-, three-and four-compartment barrels are also available.

The barrel is rotated by an enclosed variable speed drive at between 13 and 39 rpm. Any speed ranges based on a 1 to 3 or a 1 to 4 ratio can also be furnished.

As the barrel is emptied, the load slides down the chute into the motor-driven separator which separates the work and media. The hopper, which tilts for convenient emptying, and the removable drawer below provide easy handling of the separated media and work. The separating screen in the bottom of the hopper is mounted on an easily removable wood frame which prevents the work from hitting the steel sides of the hopper as it oscillates. Screens are furnished with mesh sizes and shapes to specifications. For further information, use Reader Service Card.

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MANUFACTURERS — Here is a harder-working, longer-lasting buff! Production records, where this buff is now in use, prove that the REAL-VENT is the best for the money you have ever used.

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Equipment and Supplies

E—187. Baking Enamel—Manufacturers of lamps and fluorescent fixtures will be interested in a new baking enamel recently developed by Maas & Waldstein Company, manufacturers of industrial finishes in Newark, N. J., Boston, Chicago and Los Angeles, for use on the reflector panels of light fixtures.

This material, known as Codur Gloss White Baking Enamel 68080, is said to be extremely satisfactory. Tests show 87 per cent reflectivity and ability to withstand 1000 hours humidity and 500 hours salt spray tests without breakdown. For further information and Technical Data Bulletins, use Reader Service Card.

E—188. Industrial Hand Cleaner—Department P-1, Magnus Chemical Company, Garwood, N. J., manufacturer of industrial cleaning materials and machines, now offers its powdered hand cleaners in attractive, handy five-pound containers for use in wall-mounted dispensing units. The container pouring spout eliminates waste of time and material in transfer to the receptacle used for servicing the dispensers.

The containers are packed in cartons of eight units in the following grades: Heavy Duty for cleaning unusually dirty hands, Medium (most widely used grade) for general use in most industrial plants and garages, and Superfine for office workers. The cleaner is also sold in 8-ounce cans and in bulk containers of 115 and 250 pounds.

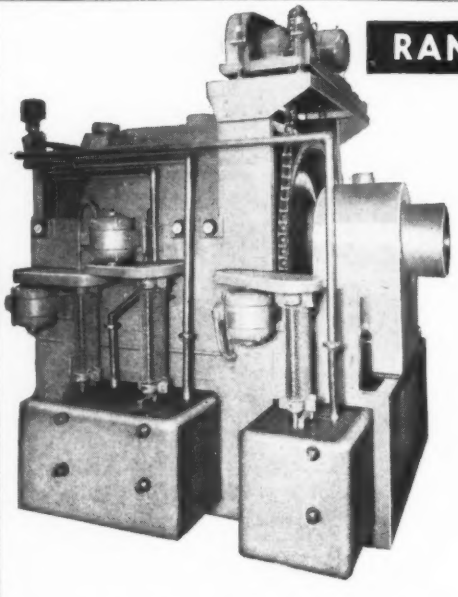
Magnus Hand Cleaner has served for nearly twenty-eight years to remove grease, paint, pitch, ink and all other hard-to-remove dirts and stains from the hands. For further information, use Reader Service Card.

E—189. Roto-Finish Mechanical Separator—A new motor-driven mechanical separator for removal of parts from chips or separating mixed chips into the various sizes is announced by the Sturgis Products Company, Sturgis, Mich. It consists of a welded steel frame with an inclined surface on which is located a hoist pan serving as a hopper, and a waste-high separating table which supports a mechanized shaker screen assembly. The inclined surface for the hoist pan support is adjustable for correct gravity flow of parts and chips onto the screen.

Motor drive can be a 110 or 220–440 volt, 3 phase, 60 cycle, geared-head ¾ hp electric motor with control switch. Dimensions of the unit are: 95 inches long, 70 inches high, and 40 inches wide, overall. For complete information, use Reader Service Card.

E—190. Automatic Parts Washer—The new portable parts washer manufactured by The Protectoseal Company, 1900 S. Western Avenue, Chicago 8, Ill., can be set up alongside production machines or can be used in maintenance and repair shops. It is constructed to offer complete fire protection in the use of flammable cleaning solvents. Washing is achieved by moving perforated basket, with contents, up and down through the solvent with the least possible turbulence and therefore permit a maximum flow of liquids over the parts. The power unit is a reciprocating air engine which provides operating efficiency without the hazard of spark ignition. In the event contents of washer should for some reason become ignited, the cover is designed to close and snuff out the fire automatically. For further information, use Reader Service Card.

E—191. Air Pressure Regulators—Series PRD and LBD Air Pressure Regulators manufactured by Hannifin Corporation, 1131 S. Kilbourn Avenue, Chicago 24, Ill., for specific applications on compressed air supply lines are equipped with a flange for panel mounting, where the adjusting knob extends through to the front of an instrument board while the valve is back of the board for convenience in connecting.



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FOR THE SURFACE TREATMENT OF METALS

For shops in which small space is available and ONE MACHINE must serve many cleaning purposes.

Here it is: AN AUTOMATIC BATCH PROCESS CLEANING MACHINE for cleaning surfaces after forging, stamping or forming . . . prior to painting or plating.

Automatic tumbling . . . cleaning . . . rinsing . . . pickling . . . soap roll and other operations in the one barrel.

Any solution can be used without loss

- Controlled operation
- No transferring loss
- Low operating cost
- Low maintenance
- Complete adaptability
- No mixing
- Improved finishes

UP TO 29 OPERATIONS IN ONLY 30 MINUTES

WRITE FOR RANSOHOFF ENGINEERS TO GIVE YOU THE DETAILS

N. RANSOHOFF, INC. CINCINNATI, OHIO

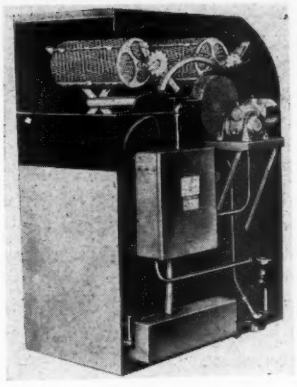
Equipment and Supplies

Both regulators are available in 3/8 and ½ inch sizes for primary pressures to 150 psi and secondary pressures or 5 to 125 psi. For further information, use Reader Service Card.

E—192. Sulfide Test Papers—L. E. Lancy Laboratories, 533 Wampum Avenue, Ellwood City, Pa., offers sulfide test papers as an aid in the control of sulfides, sodium sulfide and sodium, calcium polysulfides, etc., in bright zinc baths. The method is said to be rapid and accurate and to eliminate waste of chemicals and harmful excess additions. For further information, use Reader Service Card.

E—193. Tumble Degreaser—The new Tumbling Rotomatic, manufactured by Phillips Manufacturing Company, 3475 W. Touhy Avenue, Chicago 45, Ill., is used to clean small parts from an automatic screw machine, odd-shaped bolts, couplings, small intricately shaped castings, hollow dowel pins, and numerous other parts.

The horizontal basket holding the parts rotates as it passes through the degreasing vapor, thereby eliminating cupping action and saving a great deal of solvent. The basket is rotated by a small spur gear which in turn rotates on a large ring gear. As the reel rotates, the tumbling baskets are in turn rotated around this



ring gear as it goes down into the vapor and comes up on the other side. Each tumbling basket is fitted with a tubular shaft with a spring stub-shaft carried on one end for loading and unloading, making these tumblers readily removable by merely compressing the spring. For further information, use Reader Service Card.

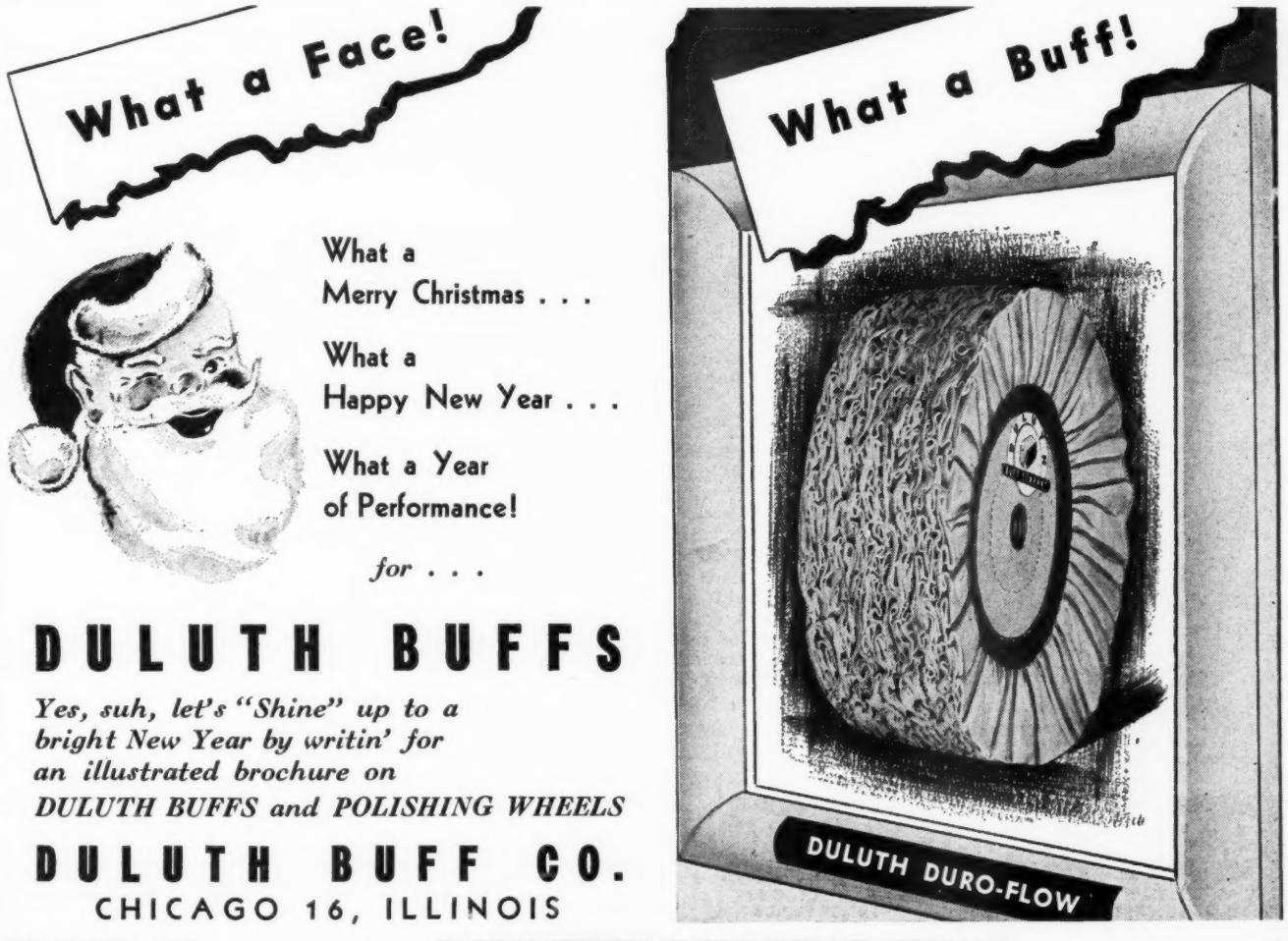
E—194. Stain and Tarnish Preventive—The Lea Manufacturing Company, Waterbury 86, Conn., has introduced LEAtardent, a protecting solution recently perfected in its laboratory. This material is used in the plating shop to prevent water staining and tarnishing of nickel plated work, brass work and, to some extent, copper, prior to operations such as lacquering, packing, plating, assembly, etc. Once treated by LEAtardent, an article can be kept around for a few days until ready for lacquering without danger of tarnishing, eliminating recleaning and drying, it is said.

LEAtardent is a liquid of about the color and consistency of milk. It is used either full strength or diluted with up to 3 parts of water as a final dip. It is used cold, but the work can be rinsed in either cold or hot water (up to 200° F). The final water rinse is optional after a diluted solution has been used. For air drying, whether in a centrifuge or on a sawdust table, the temperature should not exceed 140° F. For further information, use Reader Service Card.

E—195. Additions to Cleaner Line—The Hanson-Van Winkle-Munning Company, Matawan, N. J., has developed a new group of cleaners. In addition to the Matawan 45 and 65 series previously announced, it now offers six new Matawan numbers, each selected to meet a demand said not to have been fully satisfied before. The manufacturer states:

Matawan No. 20-W is a mild non-etching cleaner containing a synthetic wetting agent and a very effective water softener. It is primarily a soak cleaner for aluminum and will not etch its surface.

Matawan No. 20-X is a mild non-etching alkaline cleaner containing a cresylic base which aids in the stripping of paint and heavy oil films from aluminum. It is


What a Face!
What a Merry Christmas . . .
What a Happy New Year . . .
What a Year of Performance!
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DULUTH DURO-FLOW

used as a paint stripper on aluminum or an extra heavy soak cleaner on very soiled aluminum parts.

Matawan No. 25 is a non-silicated, medium caustic-base especially designed for soak etching of aluminum where the presence of a silicate would inhibit the desired etching action. It leaves the surface uniform and of low resistance. Etching is desired for appearance, for deoxidizing and lowering of surface resistance preparatory to spot welding, and for better adhesion of anodic or paint coatings.

Matawan No. 30 is a silicated, medium caustic-base cleaner containing no foaming or wetting agent. Its application is principally in spray type washing machines for steel parts where its water softening ability tends to keep the machine and jets free of lime scale. Where the presence of foaming agents in the tank is detrimental to the cleaning process, Matawan No. 30 may also be used as a direct or reverse electrocleaner.

Matawan No. 30-W is a silicated, medium caustic-base cleaner containing a wetting agent. It is ideal for the job-shop operator because it can be used on iron, steel, brass, or bronze as a soak or as an electrocleaner, anodically or cathodically. It has also found a good use as an anodic die-cast cleaner.

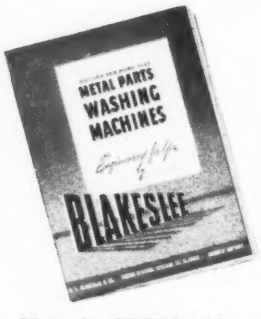
Matawan No. 50-W is an on-silicated, high caustic-type cleaner containing a wetting agent. The main usage is as a soak solution for the cleaning of magnesium. Matawan No. 50-W is particularly adaptable for this purpose prior to the Hanson-Van Winkle-Munning Manodyz process.

PAINT REALLY STICKS

WHEN METAL PARTS ARE THOROUGHLY CLEANED IN A

BLAKESLEE

METAL PARTS WASHER



To assure 100% grease free surfaces for subsequent finishes to automobile bodies, refrigerators, washing machines, toys and hundreds of other products, choose a Blakeslee Metal Parts Washer, especially adaptable to the cleaning of metal parts prior to surface treatment. Blakeslee sprays are designed to reach all surfaces and each machine is "tailor made" to do a specific cleaning job. From our experience in handling every metal piece from small watch parts to diesel engine crankcases, we have been able to build a washing machine designed to do a perfect job and to last for years.

Write for FREE booklet on Blakeslee Metal Parts Washers to answer your particular cleaning problems.

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NIAGARA METAL PARTS WASHERS

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NEW YORK, N.Y. TORONTO, ONT.

E—196. Portable Resuscitator—A new apparatus for treating pulmonary disorders resulting from exposure to certain chemicals, gases or superheated air in

industrial processes has just been announced by Mine Safety Appliances Company, Pittsburgh. It also is used for emergency cases of asphyxiation.

Developed during the war to save the lives of aircraft crew members who were wounded and required resuscitation at high altitudes, "M. S. A. Pneophore" has been withheld from commercial distribution to permit further development and widespread clinical testing at prominent hospitals.

A portable instrument consisting mainly of three valves, two gauges, rubber tubing and facepieces, the pneophore, which is said to supplant manually applied artificial respiration, differs from an ordinary resuscitator in that it administers oxygen with intermittent positive pressure only. Suction that could damge lung tissues or other parts of the respiratory system is eliminated. The instruments are used on any oxygen cylinder with a standard thread. For further information, use Reader Service Card.

E—197. Water Shedder—M. & M. Chemical Company, P. O. Box 172, Willimantic, Conn., manufacturer of soaps, cleaning and scouring compounds, announces Marco No. 410, a water dispersing agent designed to facilitate drying after plating and other treatments. A solution of 4 pounds per 100 gallons of hot water is used between two cold water rinses and ahead of the final hot rinse. Substantial savings in sawdust for drying are claimed. For further information, use Reader Service Card.

New Literature

L—147. Electronic Air Filter—Bulletin 257 describes Electro-PL, a new electronic air filter recently announced by American Air Filter Company, Inc., 215 Central Avenue, Louisville 8, Ky. This filter offers an intermediate cleaning efficiency for applications where the efficiency of a mechanical filter is too low and that of an electronic precipitator is unnecessarily high. It is basically an electronic precipitator without an ionizing unit and contains a collector element of electrostatically charged Airmat paper. This laminated cellulose product is composed of a number of plies of porous, tissue-like sheets formed of short fibres in "jackstraws" arrangement and is also used as a filtering medium in mechanical filters. When an electrostatic charge is applied to the paper, the plies tend to separate and each individual fiber becomes a collecting electrode which attracts and holds dust and smoke particles. This action practically doubles the cleaning efficiency of the paper. Since this unit will continue to function as an efficient air filter when deenergized, its operation may be varied to suit the dust condition—as an electronic air cleaner during the winter months when a smoky atmosphere is prevalent and as a dry-type air filter during the summer months. The elimination of the ionizer not only reduces the first cost of the filter below that of an electronic precipitator but also results in lowered power consumption. Maintenance is also simplified since the low-cost paper is replaced with new material when it accumulates its full dust load. For your copy, use Reader Service Card.

L—148. Data Book on Aluminum Alloys and Mill Products—Reynolds Metals Company has prepared a handy pocket-size 162-page book, "Aluminum Alloys and Mill Products Data Book", with 163 tables of data on properties and 33 pages of explanatory text covering a wide range of related subjects such as the alloy designation system, the temper designation system, heat-treatable and non-heat-treatable alloys, casting alloys, casting methods, and foundry practice.

In addition, wrought aluminum mill products and methods of producing them are described. Fabricating methods discussed include blanking, drawing, stretch forming, spinning, embossing, coining, stamping, bending, machining, forging, welding, brazing, soldering, riveting. A section on surface finishes for aluminum is also included, covering mechanical finishes, chemical finishes, electrolytic oxide finishes, electroplated finishes and organic finishes. In another section, aluminum pig and ingot products are described and their production explained. A discussion of the physical, chemical and mechanical properties is also to be found in the book, along with definitions of terms used.

A condensed table of contents on the title page quickly indicates where to look for more detailed information.

This handy wire-bound 6 x 9-inch book was prepared by Harlan D. Jones, in cooperation with other members of Reynolds Technical Service Department. It is made available without charge to those engineers, designers and technical men who send in a request on their company letterhead to Reynolds Metals Company, 2500 S. Third Street, Louisville 1, Ky. To all others, the price is $1.00 per copy.

L—149. Polishing and Buffing Supplies—J. C. Miller Company, Grand Rapids, Mich. has issued a descriptive 16-page, 3-color catalog on Buffs, Polishing Wheels, and Buffing Compounds which provides a permanent reference catalog, covering all types of buffs, polishing wheels and compounds. Included is a four-page reference section containing technical data on buffing compounds and recommendations for their use. For your copy, use Reader Service Card.

L—150. Metal Coloring Processes—An 8-page, 4-color illustrated bulletin, Ebonol Blackening Processes for Metals, has been issued by Enthone, Inc., 442 Elm Street, New Haven, Conn. It describes processes for coloring and protecting copper and copper alloys, iron and steel, and zinc and zinc alloys, and properties and applications of the finishes. For your copy, use Reader Service Card.

L—151. Price Guide for Plating and Polishing Supplies—The Udylite Corporation, Detroit 11, Mich., has issued its October, 1948 guide to prices on supplies. While not a firm quotation since some prices are subject to unpredictable quotations, it serves well for purposes of cost estimation. For your copy, use Reader Service Card.

L—152. Metal Finishing Manual—The Metal Finishing Manual, originally prepared by the National Association of Metal Finishers, Inc., for the exclusive use of its members, has now been made available to non-members, Chapter headings include Measurement Tables and Charts, 46 items; Electroplating Metal and Power Costs, and Time, 22 items; Plating Specifications and Tests, 9 items; Costs and Estimating, 4 items; Electrochemical, 4 items; and Organics, 5 items. The price of $20.00 includes that of additional sheets as prepared from time to time, several of which are now ready for distribution. Order your copy directly from the association at 2236–39 Dime Building, Detroit 26, Mich.

L—153. Pumps for Corrosives—A new 20-page Bulletin 815 on Model 40, Series M centrifugal Durcopumps manufactured by The Duriron Company, Dayton 1, Ohio includes newest design features and complete, exploded views of all parts. These pumps are designed and built exclusively for the handling of corrosive solutions, and every element in their construction is said to be calculated to increase service life, ease of maintenance, and ease of adjustment. Features include micro adjustment of impeller, replaceable shaft sleeves, patented vent ports in the impeller to relieve pressure on the stuffing box during operation, full ball-bearing construction, and non-scoring Teflon seal cages.

Every pump is adaptable to an extraordinarily wide range of corrosive service, as the wet ends are available in twelve alloys and all parts can be made interchangeable. The twelve alloys are Duriron, Durichlor, Durimet 20, Durco D-10, Chlorimet 2, Chlorimet 3, Monel, Pure Nickel, Inconel, Ni-Resist, Nickel Cast Iron and Cast Steel. This convertibility prevents pump obsolescence due to progress changes.

Detailed information is given on accessories and modifications. For your copy, use Reader Service Card.

L—154. Pivot Polishing Machines—A 4-page catalog piece issued by Hauser Machine Tool Corporation, Manhasset, N. Y., covers a line of Swiss burnishing machines, pivot polishing machines, grinding machines and attachments. The concern is the newly organized direct-distributing representative of this well-known Swiss concern. Production men may receive copies by using the Reader Service Card.

L—155. Parts Treatment Machines—American Machine and Solvents Company, 101 Park Avenue, New York 17, N. Y., has published a 4-page bulletin describing three pieces of equipment for treating parts and their applications. The first is a horizontal rotary spray-washing machine with non-clogging, flat-spray nozzles, fully accessible for adjustment. The second is a small, fully enclosed unit with a rotating receptacle for holding a work basket in oblique position during treatments. The third consists of a tank with a horizontally rotating, expanded-metal table on which is placed parts to be sprayed with the same type of nozzles as mentioned above. For your copy, use Reader Service Card.

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Reliably Rebuilt

1 YEAR GUARANTEE

6/12 Volts

1—8000/4000 Ampere, H-V-W Synch. M. D. 300 RPM
2—6000/3000 Ampere, B. & O'C. with Chandeysson synch. motor, 450 RPM
2—5000/2500 Ampere, B. & O'C. with Chandeysson synch. motor, 450 RPM
1—5000/2500 Ampere, Columbia, 690 RPM
1—2000/1000 Ampere, H-V-W, 690 RPM
1—1250/625 Ampere, H-V-W, 850 RPM
1—1000/500 Ampere, Chandeysson, 690 RPM
1—1000/500 Ampere, Columbia, 1150 RPM
1—1000/500 Ampere, H-V-W, 1150 RPM
8—125 Ampere Hobart, 6 volts

12/24 Volts

1—1000/500 Ampere, H-V-W synch. M. D. 900 RPM
1—3000/1500 Ampere, Chandeysson Synch. M. D. 400 RPM

10 V. to 60 V. Single Commutator

1—200Ampere, 11/15 V. Gen. Elec.
1—180Ampere, 14/18 V. Gen. Elec.
1—200Ampere, 15 V. Master
1—1000 Ampere, 15 V. Gen. Elec.
1—300 Ampere, 15 V Star
1—800 Ampere, 22/33 V Gen. Elec.
3—1500 Ampere, 20 V. Elec. Prods.
1—67 Ampere, 24 V. West.
1—600 Ampere, 24 V. Reliance
1—200 Ampere, 25 V. Star
1—1000 Ampere, 25/35 V. Diehl
1—300 Ampere, 25 V. Star
1—175 Ampere, 25 V. Cr. Wh.
1—500 Ampere, 32 V. Columbia
2—100 Ampere, 30 V. Gen. Elec.
1—200 Ampere, 30 V. West.
2—200 Ampere, 32 V. Gen. Elec.
2—1500 Ampere, 32/40 V. Elec. Prods.
1—1000 Ampere, 33 V. Gen. Elec.
2—200 Ampere, 42 V. Gen. Elec.
3—1500 Ampere, 45 V. Century
1—1500 Ampere, 50 V. Gen. Elec.
2—800 Ampere, 50 V. Gen. Elec.
1—400 Ampere, 50 V. Gen. Elec.
6—1500 Ampere, 50 V. Elec. Prods.
1—1000 Ampere, 60 V. Gen. Elec.

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A. E. S. News

A. E. S. Receives Certificate

The Executive Secretary's office has recently received a framed certificate which reads as follows:

14 Pt Cloister Text, c. & l. c.—

The Lehigh University
Institute of Research

This is to Certify that
American Electroplaters' Soc ety
i, participating in a cooperative research program of the Lehigh University Institure of Research devoted to the pursuit of more exact knowledge in science and in the applications of science to the affairs of modern life.

(Signed) M. H. WHITAKER
President.

The letter which accompanied this certificate, signed by H. A. Neville, Office of the Director, reads in part as follows:

"The intent of this certificate is to express our sincere appreciation of your cooperation and support in the search for new knowledge and in the essential training of research scientists. We trust that you will be pleased to accept this certificate and proud to display it.

"It is our opinion that industry and the universities share a common interest in the progress of education and research. It has been amply demonstrated at Lehigh University and at other institutions that a closer cooperation with industry can result in mutual advantages. We are therefore pleased that Lehigh University has the opportunity to cultivate this association with you, and we are hopeful that it will have significant value for all concerned".

It is sincerely appreciated.

A Correction

Mr. W. R. Huey succeeded Mr. Manley Ross on A E S. Research Project Committee No. 10, not Mr. Malcolm Orr as incorrectly stated in the November issue.

Our apologies to Mr. Orr, who happily remains on the Committee.

Tin Plate Movie Available

President S. S. Johnston advises that the movie, "Tin Plate", which was made in the plant of Weirton Steel Company last summer, will be available for Branch showing following the "Can Makers" convention in Atlantic City in the latter part of January. Those desiring to use the film should address their request to Mr. S. S. Johnston, c/o Weirton Steel Company, Weirton, W. Va.

Plate Distribution Research Started

A. E. S. Research Project No. 11 on "Current and Metal Distribution in Electroplating" has been placed in Evansville College, Evansville, Ind., with Dr. John Kronsbein as Project Director.

The committee in charge of this project consists of Dr. R. A. Schaefer, Cleveland Graphite Bronze Company, Chairman; Dr. Harold J. Wiesner, Bendix Products Division, Bendix Aviation Corporation; and Mr. Leonard E. Weeg, National Lock Company.

Dr. Kronsbein, who recently accepted the position of Professor and Head of Chemical Engineering at Evansville College, was previously in charge of development and research at Hoosier-Cardinal Corporation in Evansville and consultant on heat treatment and electroplating for Illinois Tool Works in Chicago and Elgin, Illinois. Before that, until four years ago, he lived in England, where he developed the cuprous oxide plating rectifiers beginning in 1934, designed and built a number of full automatic plating machines, and evolved a high speed brass plating bath capable of operation at 25 to 30 asf, to mention only a few of his best known accomplishments. His appointment to carry out the A. E. S. Research Project came as a result of his many important studies in that field.

It is anticipated that at least two years will be required to provide a reasonable amount of information on this subject.

1949 Convention Papers

The Editorial Board met with Mr. Leslie Diveley, Educational Chairman for the Milwaukee Convention, in New York City on October 13.

It is planned to devote one session to a symposium on "Plating as a Business" with invited speakers on several pertinent topics. Another session will be given over to A. E. S. Research which is now producing such worthwhile results. A third session will be a Round Table discussion of practical plating problems. This leaves two or three sessions for other technical papers.

Papers on electroplating and allied subjects are invited. A special invitation is given to the younger men of the Society who have presented papers before their Branches but who have not yet attempted to talk before a Convention.

Request an offer form now from the Editor, American Electroplaters' Society, P. O. Box 168, Jenkintown, Pa.

Copies of January and March Issues Desired

The Executive Office has only a few copies left of the January and March, 1948 issues of PLATING.

If those who do not plan to keep their copies would send them to P. O. Box 168, Jenkintown, Pa., their assistance will be very much appreciated.

Branch News

Coming Events

NEWARK BRANCH

ANNUAL EDUCATIONAL MEETING AND CHRISTMAS PARTY

Saturday, December 18

in Robert Treat Hotel, Newark, N. J.

Educational Session at 2:00 P. M.

Mr. A. W. Logozzo, President, Nutmeg Chrome Corporation and First Vice-President, A. E. S., "Bright Nickel and Decorative Chromium Problems"

Mr. F. Oplinger, Manager, Electroplating Department, E. I. du Pont de Nemours & Company, Inc., "Copper Plating"

Dr. E. M. Wise, The International Nickel Company, "Plating of Precious Metals"

Banquet at 7:00 P. M.

GEORGE WAGNER, *Secretary*

BALTIMORE-WASHINGTON BRANCH

The first meeting of the 1948–1949 season was held in Mullineaux's Lounge, Catonsville, Md., on October 12.

The speaker of the evening was DR. C. FRED GURNHAM, Chemical Engineering Consultant, Hamden, Conn. He is also Chairman of A. E. S. Research Project 10 on Disposal of Plating Room Wastes, which he discussed in his interesting talk. He emphasized the need for treatment of plant wastes to prevent pollution of streams, rivers and water supplies, pointed out the source and extent of pollution from various plating processes, and explained and evaluated methods of treating waste solutions of acids, heavy metals, chromates, alkalis, and cyanides.

FIELDING OGBURN, *Secretary*

CHICAGO BRANCH

The speaker at the meeting on October 8 was MR. H. HASSEL of the Sturgis Products Company, who gave a talk accompanied by movies on "Roto-Finishing", a method for deburring, burnishing and polishing of metals by tumbling. It was greatly enjoyed by the 138 members and guests who attended.

"STU" KRENTEL of MacDermid, Incorporated, recently visited and saw many of his old friends here. Both he and his wife like California, in fact his wife did not accompany him on this trip.

ARTHUR G. BARTMANN, *Correspondent.*

CLEVELAND BRANCH

The guest speaker at the October 1 meeting was MR. C. E. MACKINNON of E. I. du Pont de Nemours & Company. Mr. McKinnon spoke about the use of diaphragms in electroplating, and dwelt mainly on the mechanics of the diaphragm and the effects of solution flow and free cyanide content on anode corrosion in cyanide copper plating.

At this meeting Miss Betty Luce, Research Chemist with Cleveland Graphite Bronze Company, became the first woman to be elected to membership in the Branch.

There was some discussion on the perennial question of industrial exhibits at Annual Conventions. The general feeling of the members present was that such exhibits should be scheduled only once every three years.

HARRY POCHAPSKY, *Secretary*

DAYTON BRANCH

The meeting on October 10 was held in the Engineers' Club.

As the scheduled speaker was unable to be present to deliver his address on "Electropolishing", one of our members, FRED BAUCH of the Frigidaire Division of General Motors Corporation, volunteered to give the talk. He dwelled mainly on the practical aspects, such as selection of solution, its preparation and cost, potentials and current densities required, racks and racking, bath heating and cooling, etc., and especially what to expect from electropolishing. The spirited discussion which followed showed the great interest in this process.

The October 12 plant tour of Electric Autolite Company Bumper Division in Sharonville was enjoyed by all who attended. All operations from start to finish are performed in this plant.

FRED BAUCH, *Secretary*

HARTFORD BRANCH

The meeting on October 18 in Hotel Bond found seventy members present. It began with an interesting movie showing plating waste disposal plants and purification of streams and outlets, after which MR. GEORGE B. HOGABOOM reported on "Latest Developments in Plating".

DR. LOUIS WEISBERG, well-known Consulting Chemist of New York City and Chairman of A. E. S. Research Committee, spoke on the progress of the research activities and then discussed distribution of plate.

Refreshments were served at the end of the meeting through the courtesy of the Chemical Corporation.

RALPH D. CHASE, *Secretary*

LANCASTER BRANCH

On Friday, October 8 at 2:00 P. M. forty-one members and guests assembled at the American Chain and Cable Company's York Plant. After a very interesting and educational tour of the plant, which makes chain and other allied products, the group was entertained at a dinner given by the company in the Homestead Inn, West York. We were honored by the presence of MR. GEORGE SCHMIDT, General Manager of the York Division, who spoke briefly about plating room wastes and what his company was doing about them.

We then heard an excellent lecture on "Brass Plating" given by DR. A. K. GRAHAM, Executive Secretary of the A. E. S. He was introducd by his old schoolmate, NORMAN GEBERT. Dr. Graham's talk was well illustrated by graphs and charts showing the importance of bath temperature and ammonia content in the control of the brass color. A question and answer period followed.

HARRY HOVIS was appointed chairman of the Christmas Party. Seven membership applications were received.

CHARLES SNYDER, *President*

LOUISVILLE BRANCH

The meeting on October 21 was held in Room 119, Speed Scientific Building, University of Louisville.

MR. ARTHUR OERTEL of the J. V. Pilcher Company reported in a most interesting manner his activities during the Atlantic City Convention. STANLEY J. BEYER, who previously had been appointed Branch Research Committee Chairman, then spoke "off-the-cuff" on brass plating. His talk might have been titled, "How Little We Know About Brass Plating". LIBRARIAN ALLISON followed with details of the processes used in chromium plating of gun barrels.

MR. C. BOHANNAN was scheduled to follow with additions to Mr. Allison's talk, but time was running short and his presentation was withheld until some future date.

STANLEY J. BEYER, *Secretary-Treasurer*

MELBOURNE BRANCH

The thirty-seventh regular meeting of the Branch was held in the Victorian Chamber of Manufactures on 27th September with thirty-five members and visitors present.

After a short business session LIBRARIAN H. TEAGUE introduced the two speakers for the evening. MR. H. I. LITTAUER spoke on "The Dyeing of Anodised Aluminum" and was followed by MR. C. E. NAYLOR who discussed "The Coloration of Stainless Steels". Both speakers illustrated their excellent talks by handing specimens to the audience, and were kept busy answering questions for a considerable time.

JOHN J. DALE, *Honorary Secretary.*

MONTREAL BRANCH

Twenty-three members and guests attended the Fall opening meeting in Mount Royal Hotel on September 14.

The meeting was devoted to reports on the Atlantic City Convention by some of the members who attended. Three speakers, J. H. FEELEY, F. R. LUNN, and J. COURTEMANCHE, had derived much benefit from and greatly enjoyed the Indus-

trial Finishng Exposition. G. R. DAVIDSON considered the convention very successful in view of the distance from certain industrial centers, but J. D. FAIRBAIRN expressed regret that there were no plating plants in the immediate vicinity that could have been visited. J. COURTEMANCHE found the Technical Sessions too technical.

Two new members were elected.

B. MENDELS, *Secretary-Treasurer*

NEWARK BRANCH

Fifty members and guests attended the meeting on October 1, at which one applicant was elected to membership and four new applications were received. There were also two out-transfers, one in-transfer, and three suspensions for non-payment of dues.

The annual dues were raised from $8.00 to $10.00 per year, starting with the fiscal year which begins on April 1, 1949. PRESIDENT ZACHARY IRENAS appointed HORACE SMITH and JOHN DE VRIES Co-Chairmen of the Christmas Party. These men will appoint other members to serve on the committee.

LIBRARIAN EDWIN BOWERMAN then introduced DR. WALTER R. MEYER, President of Enthone, Inc., who presented a very interesting paper on "Preparation of Metal Surfaces for Electroplating". His talk was supplemented by many slides of photomicrographs of metal surfaces and drawings of how surface active agents might look structurally and their activities in cleaning solutions. Each member and guest attending received a copy of the paper. Questions asked at the conclusion of the talk dealt with the use of silicate cleaners, cleaning of zinc base die castings, testing for the life of a cleaner, etc. Dr. Meyer's answers were clear and to the point.

By an oversight, the election of HORACE H. SMITH to honorary membership of the Branch was omitted from the report of the September 17 meeting. Mr. Smith is one of the founders of the A. E. S. and a Past President and Honorary Member of the Society.

NEWARK BRANCH

The meeting on October 15 was attended by sixty members and guests, among them DRS. R. M. WICK and G. DUBPERNELL and MESSRS. K. G. SODERBERG and DAVID CLARIN from other Branches. The two latter said a few words, complimenting the Branch on the manner in which it is being run.

Four men were elected to membership. There were also one new application for membership and one out-transfer.

JOHN DE VRIES, Chairman of the Christmas Party, announced that it will be held on December 18 in the Robert Treat Hotel. ED BOWERMAN had lined up speakers and PAUL OLDAM was hard at work on the entertainment.

Librarian Bowerman then introduced DR. LOUIS WEISBERG, Consulting Chemist, New York City, who spoke on "Smoothing Action in Nickel Deposition". In his well presented talk Dr. Weisberg gave a description of the method of measuring surface characteristics by the brush analyzer technique and showed numerous slides illustrating the surface patterns of steel. The data presented demonstrated how the leveling action of nickel from a 9H modified solution on steel increased with the temperature and degree of agitation of the bath and through reduction of most impurities in the solution. Brightness is not necessarily a result of leveling action. Over fifteen questions were asked at the conclusion of his presentation, dealing with such topics as commercial aspects, the leveling action of nickel from other solutions, applicability of the method to other metals, and effect of the nickel deposit, undercoating of copper, and anodic etch on the smoothing action.

S. S. FREY, *Recording Secretary*

NEW HAVEN BRANCH

At the meeting on October 12 TECHNICAL CHAIRMAN MALCOLM A. ORR introduced MR. RICHARD ROY ROSCOE, General Foreman of Finishing of Tubular Rivet and Steel Company, Wollaston, Mass., who spoke about "Processing and Finishing Parts in Bulk". He also showed a large display of plated finishes, among them fine examples of barrel chromium plated parts.

B. J. GAFFNEY, *Secretary-Treasurer*

PHILADELPHIA BRANCH

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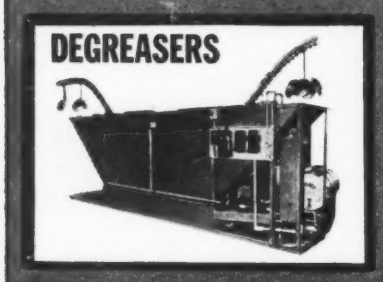

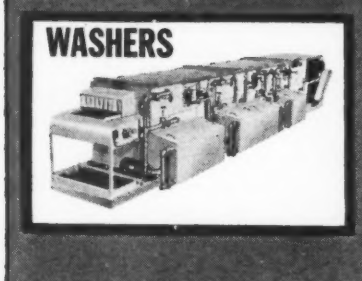

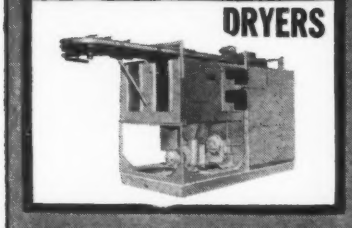

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was the speaker on October 22. His talk on "Full Automatic Plating Conveyors" was illustrated with moving pictures showing several typical large operations in use.

The Secretary spoke on the activities and scope of the Branch Employment Committee. He suggested that the members avail themselves of the opportunity to make it the clearing house for situations vacant or wanted.

LIBRARIAN ALBERT HIRSCH presented a motion that a committee be appointed to determine if a day course in electroplating could be established in the Philadelphia Public Schools. The motion carried, and PRESIDENT RODGERS advised that the committee appointments would be announced at the next meeting. Mr. Hirsch also pointed out what an important aid the A. E. S. Manual for Electroplaters' Science Course could be to instructors in electroplating.

The question box brought forth the following:

Q. 1. What is the cause of rainbows in chromium plate? *A.* Low sulfate ratio, low current density, differences in temperature at different levels of the tank, faulty cleaning.

Q. 2. How should 500 gallons of phosphoric acid be treated for dumping? *A.* Mix with a lime slurry before dumping.

Q. 3. How should lead-alloy slush castings be prepared for copper, nickel and chromium plating to prevent blistering?

A. A minimum amount of cleaning should be done, using a mild cleaner, followed by a weak acid dip.

I. WM. MARCOVITCH, *Secretary*

PITTSBURGH BRANCH

On October 14, thirty-four members were present for the dinner meeting and fifty-four members for the business and educational meeting in the Sheraton Hotel.

Following the showing of a moving picture of the 1946 season of the Pittsburgh Steelers Football Team and the election of eight new members and acceptance of one in-transfer, DR. EDWIN MARTIN of Inland Steel Company gave a very interesting and informative illustrated lecture on "Electrolytic Tin Plate". A very enthusiastic discussion ended the meeting.

GLADE B. BOWMAN, *Secretary-Treasurer*

PROVIDENCE-ATTLEBORO BRANCH

A business meeting of the Executive Board of the Providence-Attleboro Branch was held in the offices of Technic, Inc., on August 16 to formulate plans for the activities of the Branch during the coming year.

At the September 20 meeting in the Sheraton-Biltmore Hotel, MR. M. C. WELKER of the Ion Exchange Products Division of American Cyanamid Company discussed applications of "Deionized Water in the Plating Room" for the final rinse to eliminate spotting and to make up plating solutions. Recovery of precious metals and elimination of waste products from rinse waters by means of cation exchange resins were also treated. Mr. Welker showed the American Cyanamid 16-mm sound-color film, *Water, Water Everywhere*, which demonstrated the uses of deionized water and the manufacture of the resins. A pictorial presentation purification process is an interesting part of the film.

ROBERT MACLACHLAN was appointed chairman of the local Research Fund Committee. Other members of the committee are ERNEST HOAR and JOHN BROADBENT, JR.

Attendance was forty-six including seven guests.

MR. WESLEY CASSELL, Lea Manufacturing Company, Waterbury, Conn., was the speaker at the October 18 meeting. His talk on "Plating Room Engineering" was well received and promoted considerble discussion. The full paper is published in the 1948 *Platers' Guidebook.*

One applicant was elected to membership and there was one in-transfer.

EDWARD A. PARKER, *Secretary*

ROCHESTER BRANCH

Three new applications for membership were received at the meeting on October 15. RAY BERGHOLD was elected Chairman of the Christmas Party which will be held on December 18.

MR. A. J. CHANDLER of the Osborn Brush Company gave an interesting talk on "The Use of Brushes in Metal Finishing". It was illustrated with slides, samples of parts which had been finished with brushes, and samples of various types of brushes manufactured by his company.

JAMES WEAVER, *Secretary*

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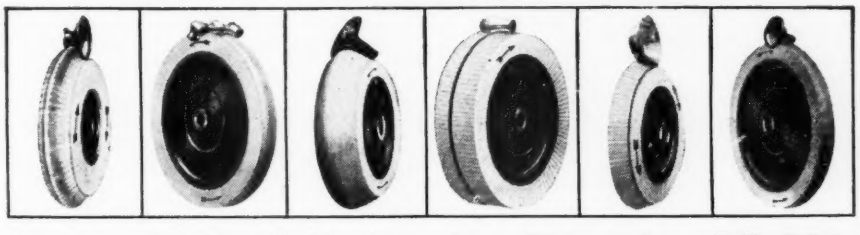

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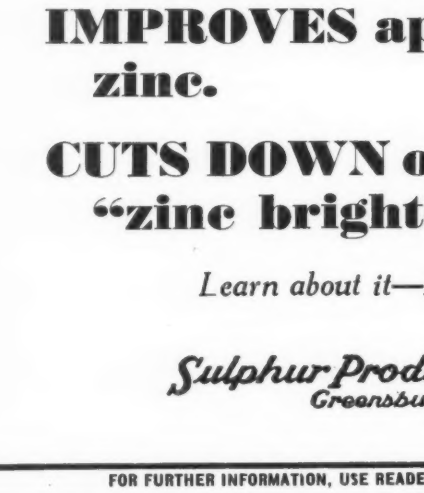

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ST. JOSEPH VALLEY BRANCH

Twenty-three members and guests were present at the regular monthly dinner meeting in Hotel Elkhart on October 6. One application for membership was received.

Mr. Ray V. Dawney, Rectifier Engineer of the General Electric Company, delivered a very interesting talk entitled, "Around the Clock with the Rectifier". His subject was illustrated with a series of slides showing the many uses for rectifiers in every day life. In connection with plating, Mr. Dawney spoke on the important types of rectifiers used today, paying particular attention to the current and voltage overload characteristic as well as to precautions to be observed in installation and maintenance to assure proper performance.

Mr. Dawney was followed by Mr. Link of General Electric Company, Detroit, who presented a comparative analysis of cost and efficiency of various types of rectifiers used in plating. It was the contention of both speakers that the life of the rectifier compares well with the life of the generator and that for certain types of installations rectifiers were the more suitable. A brief question and answer period followed.

Victor E. Peterson, *Secretary-Treasurer*

SOUTHEASTERN BRANCH

The meeting on October 14 was presided over by David Griffin in the absence of the president. It was held in the dining room of the Roebuck Country Club, Birmingham, Ala.

The speaker, Mr. Arthur W. Logozzo of the Nutmeg Chrome Corporation, Hartford, Conn., gave a very instructive, illustrated talk on "Bright Nickel and Decorative Chromium Problems". The discussion which followed indicated deep interest in the subject.

The question as to the desirability of meeting in other towns than Birmingham and Atlanta in order to encourage wider membership was referred to committee.

Dr. Fred W. Cox, Jr., of the Southern Research Institute, Birmingham, was appointed chairman and H. Y. Carson member of the Branch Research Committee.

Wm. T. Weymouth, *Secretary-Treasurer*

SYRACUSE BRANCH

The meeting in the Hotel Syracuse on October 18 featured Mr. Paul Swartz of the L. C. Smith and Corona Typewriters, Inc., who presented his paper on "Conveyorized Spray Painting Systems". At the conclusion of the talk considerable time was spent discussing problems which might come up on an installation of this sort. The attendance numbered twenty-eight.

Hereafter the monthly meetings will be held in the Hotel Syracuse on the third Monday of each month.

V. P. McConnell, *Secretary*

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Plating Activities

(*Continued from page 1227*)

ganese. If means could be found to stabilize the δ-manganese, other than keeping it in a refrigerator, this metal might find application as a protective coating.

Dr. W. A. Wesley and H. R. Copson of The International Nickel Company have found that up to 0.00003 inch thick nickel immersion deposits on steel can be had in nickel chloride solutions. Very thin deposits have been used in the preparation of steel for fire-enameling for many years but have not been closely controlled. The present heavier deposits can be made adherent by high-temperature heat treatment.

Plating of high tin-zinc alloys from stannate-cyanide baths was the subject of a paper by J. W. Cuthbertson and R. M. Angles of the Tin Research Institute, Middlesex, England. The resulting coatings had almost constant composition over a wide range of current densities and were said to be superior in rust protective value to equally thick zinc or cadmium coatings and easily solderable.

A new bath for nickel plating making use of the orthophosphates was described by Dr. C. B. F. Young and E. S. Roszkowski of Brooklyn Polytechnic Institute. The coatings were matte and adherent.

I. Larson of E. I. duPont de Nemours & Company and R. W. Moulton and G. L. Putnam of the University of Washington reported the physical properties of iron deposited from the "Ekko" chloride bath. Average tensile strength varied from 37,700 to 68,700 psi with elongations of 0 to 12.5 per cent, the main bath variable being pH.

The work on electrowinning of chromium from trivalent chromium baths now carried on at Boulder City, Nevada by U. S. Bureau of Mines and reported by R. R. Lloyd may in time become important to the chromium plater who gets tired of his low-efficiency hexavalent-chromium processes.

Finally, plastic coatings and their anodic deposition were described by Colin G. Fink and Morris Feinleib of Columbia University. The low tank voltages used were especially interesting.

The meeting with its accent on new development was most stimulating to the many research workers and engineers who attended.

CORRECTION

The footnote on page 1110 of the November issue should read: "See also C. H. Faust, 'Electropolishing—What Is Its Status Today'? Proc. Am. Electroplaters' Soc. 33, 49–74 (1946), and J. Mazia, 'Electrolytic Polishing Theory and Practice'. Monthly Rev. Am. Electroplaters' Soc. 34, 937–944 (1947)".—EDITOR.

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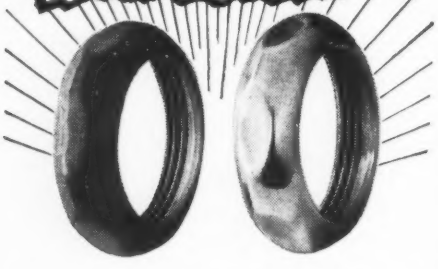

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Adhesion of Electrodeposits

(*Continued from page 1221*)

DEAR MR. HOTHERSALL:

I am very glad to have your comments, as I am well aware of your extensive interest and splendid work on the subject of adhesion.

As you say, we are basically in agreement that the situation is confusing and needs clarifying. Our disagreement is principally in the selection and definition of terms. Yet, I have the impression that you do not desire to recognize two independent situations of great practical importance, regardless of what name we give them. I am referring, of course, to Fig. 2 in the March article. When a plated part fails near the plate for reasons not associated with the workmanship of plating, a condition exists entirely separate from simple detachment of the plate due to poor workmanship. One situation is related to metallurgical properties of the metals and the other to the workmanship in finishing and plating. Each needs its own term and should not be referred to as a matter of "degree".

When the "adhesive strength" of a plate at the interface between itself and the "surface" of the basis metal exceeds the strength of either metal, there is no practical need to know the numerical value defining the strength at the precise interface. Adhesion has been too loosely used to cover all types of failures.

According to my definition of "adhesive strength", there is only good and poor adhesion. In my opinion, there is no need to consider the situation of a nonmetallic film between plated coating and basis metal. This relates either to poor workmanship or to an improper application and should not be allowed to confuse the issue.

"Adhesion" has been most extensively used to define the "stick" of a plated coating. Shear strength and tensile strength are inherently associated with plated coatings and need separate identification in the consideration of any quality discussion.

You say, "As I pointed out in my reply to the discussion, the most that could be said about the adhesion of this cadmium to this nickel was that it was greater than the strength of the cadmium—how much greater no one can say." With this, I agree. I would add that one cannot and should not ask for more. According to my proposed selective definitions, I would interpret this situation by saying that the bond strength is clearly and quantitatively defined by the tensile and shear strength of the cadmium plate. These are strengths having meaning to an engineer who must prescribe the service needs. I would also say that, as you pointed out, we do not know the actual adhesive strength across the cadmium-nickel interface and that we do not need to know the precise quantitative value. The "adhesive strength" is good; whether it is 75 per cent, 80 per cent, or any other per cent of perfect is of no practical consequence.

On the other hand, if the part had failed at less than the strength of the cadmium plate, "adhesive strength" might have been poor or the cadmium plate might have been inferior. Only a careful examination would show which one. Or, as my Fig. 2 shows, the basis metal itself might cause the incorrectly interpreted "poor adhesion".

It is difficult to adequately discuss a topic such as this one by letter, but I appreciate your interest in doing so. I believe that your comment, "I do not think that the term used to describe this interfacial strength is at all important provided that it distinguishes between the strength of bond at the metallic interface and the mechanical force required to separate the coating irrespective of where fracture takes place; and that the terms selected do not in any sense in which they may legitimately be used contradict the ordinary, everyday meaning of words", incompletely covers the situation. It is important to identify where the fracture occurs if fabricators, metallurgists, and platers are to produce cooperatively the best product performance.

The situation has relatively little importance in the field of decorative and protective plating against mild corrosion, but is very important for successful use of electrodeposited metal coatings in engineering applications such as bearing manufacture, building up of worn parts, surfacing for high-temperature erosion where high strength is required, etc.

My chief concern is with the fact that poor adhesion implies poor workmanship in the finishing department, many times unjustly and incorrectly. I want a term that identifies the nature of the failure when a plate comes off. I would like to have words that need no qualifying comments.

In closing, I agree with your closing remark that our main disagreement is in selection and definition of words. This will always be arbitrary, and I too believe that Americans and Britons should agree on terminology.

Sincerely yours,

(Signed) CHARLES L. FAUST.

Further comments on this subject are invited. Of special interest would be reports on new methods of measuring "bond strength," not covered by Dr. Ferguson's survey.—EDITOR.

Membership Report

of the American Electroplaters' Society

Elections

ADELAIDE BRANCH: P. Nash

BALTIMORE-WASHINGTON BRANCH: George E. Best, Harry B. Chew, Sr., Victor Zentner

BRIDGEPORT BRANCH: L. C. Bennett, N. Genovese, R. J. Peck, A. W. Sweet

CHICAGO BRANCH: John Liez, T. J. Malicki, King Ruhly, Albert H. Smith, William R. Strelow

CLEVELAND BRANCH: H. C. Deichert, Betty Luce, Joseph Mutko

COLUMBUS BRANCH: Harold P. Edelstein, Grover C. Mills

DAYTON BRANCH: J. A. Cappi, Ralph Casey, G. D. Comer, E. D. Cummins, R. Kuhbander, P. Herring, L. Lindsey

DETROIT BRANCH: Paul P. Chevis, Henry W. Grikscheit, Orlo P. Portman, William P. Reece, Albert Reinick, R. A. Saunders, Elwood L. Scholl, Paul W. Sheppard, Hoffman Stone

HARTFORD BRANCH: W. L. Acker, E. L. Hack, H. Maynard, Robert V. Sanford, J. K. Werner

JACKSON-LANSING BRANCH: R. P. Blake, L. B. Johnson, C. C. Nicholas, R. C. Waugh

NEWARK BRANCH: Correction: Stephen Wray, Jr., elected in error

PROVIDENCE-ATTLEBORO BRANCH: Edward C. Garabedian

LOUISVILLE BRANCH: John Kehrer

ST. JOSEPH VALLEY BRANCH: Charles S. Shue

SYDNEY BRANCH: M. W. Brown

WATERBURY BRANCH: L. H. Maker

MEMBERSHIP-AT-LARGE: Vicente Massuet Grau, P. M. Makadia

Reinstatements

BALTIMORE-WASHINGTON BRANCH: Jules Horlick

PHILADELPHIA BRANCH: H. Wright

Transfers

R. E. Pettit to Chicago Branch; E. J. Roehl from Newark Branch to Cleveland Branch; T. R. Smith to Detroit Branch; H. C. Schlaupitz from Hartford Branch; W. G. Sheane from Newark Branch; F. L. Hintze from Newark Branch; Charles Geldzahler from New York Branch; Harold Frohwitter from Philadelphia Branch; William R. Pfeiffer, Jr., from Philadelphia Branch; Donald Morris to Syracuse Branch; R. M. Norton from Syracuse Branch; W. E. Bruse from Louisville Branch; George Perkins to Louisville Branch; Ronald Shaw to Pittsburgh Branch; Herbert K. De Long to Saginaw Valley Branch

MEMBERSHIP CHART

	Membership May 1, 1948*	New Members	Net Change in Membership	Per Cent Net Change
FIRST GROUP				
TORONTO	143	9	+ 9½	+ 6.6
CLEVELAND	190	13	+11	+ 5.8
DETROIT	407	15	+13½	+ 3.3
BOSTON	163	3	+ 3	+ 1.8
BRIDGEPORT	154	10	.....	.....
NEWARK	280	7	− 2	− 0.7
LOS ANGELES	234	1	− 3	− 1.3
GRAND RAPIDS	148	..	− 3½	− 2.4
NEW YORK	270	9	− 6½	− 2.4
PHILADELPHIA	205	7	− 8	− 3.9
WATERBURY	128	3	−11½	− 9.0
HARTFORD	150	5	−21	−14.0
PITTSBURGH	149	1	−21	−14.1
CHICAGO	445	13	−78½	−17.6
SECOND GROUP				
SYDNEY	91	23	+18	+19.8
NEW HAVEN	110	5	+ 5	+ 4.5
BUFFALO	94	5	+ 2½	+ 2.7
MILWAUKEE	124	6	+ 3	+ 2.4
INDIANAPOLIS	103	2	+ 2	+ 1.9
DAYTON	90	7	+ 1	+ 1.1
PROV.-ATTLEBORO	117	6	+ 1	+ 0.9
SAN FRANCISCO	77	..	.....	.....
ST. LOUIS	103	..	.....	.....
CINCINNATI	80	..	− ½	− 0.6
BALTIMORE-WASH.	96	3	− 4½	− 4.7
TWIN CITY	77	2	− 5	− 6.5
ROCHESTER	120	3	− 9½	− 7.9
ST. JOSEPH VALLEY	98	3	−11½	−11.7
THIRD GROUP				
SAGINAW VALLEY	38	7	+14	+36.8
MELBOURNE	68	12	+12	+17.6
ADELAIDE	65	14	+10	+15.4
LOUISVILLE	18	3	+ 2	+11.1
MONTREAL	63	3	+ 3½	+ 5.6
JACKSON-LANSING	64	6	+ 2½	+ 3.9
LANCASTER	46	2	+ 1	+ 2.2
COLUMBUS	38	7	+ ½	+ 1.3
ROCKFORD	59	..	.....	.....
SYRACUSE	66	8	− ½	− 0.8
SPRINGFIELD	53	1	− 2	− 3.8
TOLEDO	73	..	− 4	− 5.5
SOUTHEASTERN	49	2	−15	−30.6
OTHERS	114	29†	+28½	+25.0
TOTAL A. E. S.	5,260	256	−59	− 1.1

Active Membership, November 5, 1948 5,201

*Subject to correction.

†Including 21 in Allentown-Reading Branch.

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BALTIMORE-WASHINGTON BRANCH: Wilbert S. Ermlich, Robert Seegmiller

COLUMBUS BRANCH: Iver Igelsrud, Waldemar Ruemmler, Elmer Stephen

DAYTON BRANCH: Robert H. Ball, Virgil C. Hutton

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GRAND RAPIDS BRANCH: Carl F. Wallgren

LOUISVILLE BRANCH: W. H. Hopkin

PROVIDENCE-ATTLEBORO BRANCH: George Breault, Alfred Nelson

MEMBERSHIP-AT-LARGE: David F. Green

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BALTIMORE-WASHINGTON BRANCH: Grace E. Riddell

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(Continued on page 1274)

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Plating

December 1, 1948

Dear Reader:--

The current issue concludes Volume 35 of this publication--the twelfth issue under the name of PLATING.

The days of the small-size "Monthly Review" seem in the distant past when one glances through this issue. The larger page-size, the more spacious format, the increased amount of editorial content are now the desired and accepted features of PLATING. The expected complaint on the part of some that the new size wouldn't "fit into the pocket" has never been heard because the obviously good features outweighed any slight inconvenience in the matter of carrying an issue from plant to home, or vice versa.

We of the editorial staff are happy to report that there will be continuing efforts to make PLATING more valuable, more attractive to you the reader. Your production problems are our problems. Your need for basic information on all aspects of electroplating and finishing will continue to guide our editorial efforts.

I state in all confidence that you may look forward with anticipation to all the 1949 issues of PLATING. We sincerely hope that you will find them as interesting and helpful to you as we believe they will be.

Meantime, the entire editorial and business staff of PLATING joins with me in wishing you a Very Merry Christmas and a Happy and Prosperous New Year.

Sincerely,

Gustaf Soderberg

Editor.

Future Meetings

NEWARK BRANCH, A. E. S. Annual Christmas Party and Educational Session in Hotel Robert Treat on December 18. Educational Session at 2:00 P. M., Banquet at 7:00 P. M.

THIRD NATIONAL MATERIALS HANDLING SHOW in Convention Hall, Philadelphia, on January 10–14.

GRAND RAPIDS BRANCH, A. E. S. Annual Educational Session and Dinner-Dance in Pantlind Hotel on January 29.

A. S. T. M. SPRING MEETING AND COMMITTEE WEEK in Hotel Edgewater Beach, Chicago, on February 28 to March 4.

BOSTON BRANCH, A. E. S. 14th Annual Banquet and Technical Session in Hotel Statler on Saturday, April 16.

AMERICAN ELECTROPLATERS' SOCIETY. Annual Convention in Hotel Schroeder, Milwaukee, Wis., on June 27 to 30, 1949.

A. S. T. M. FIFTH-SECOND ANNUAL MEETING in Chalfonte-Haddon Hall, Atlantic City, N. J., on June 27 to July 1, 1949.

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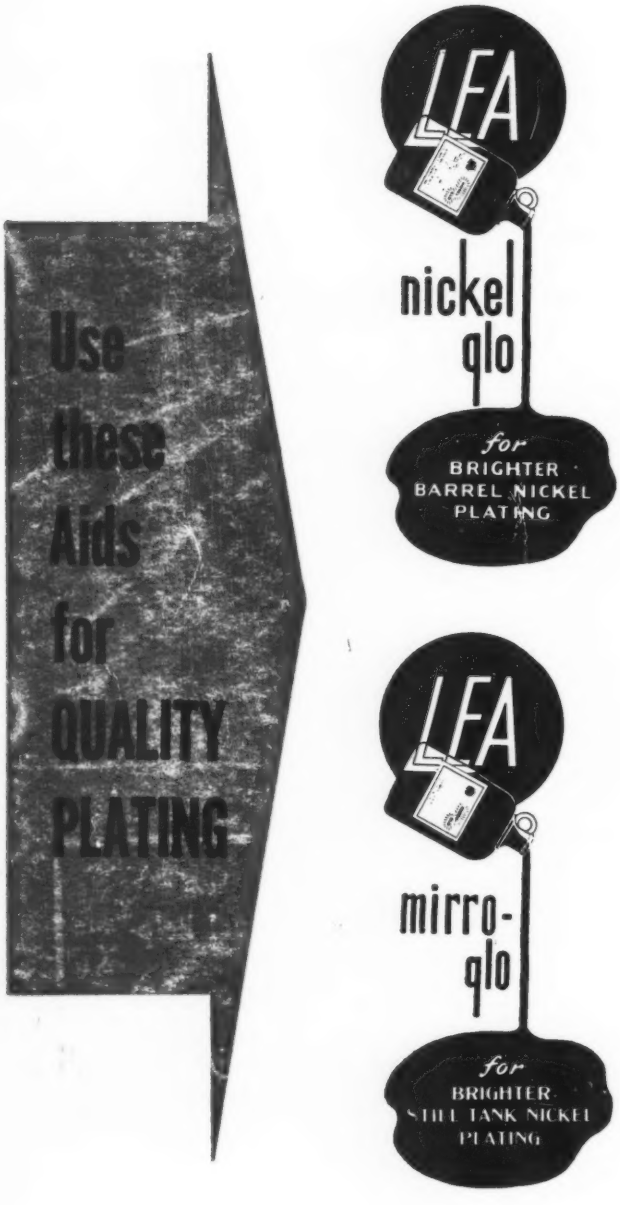

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